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ABSTRACT

This report describes eight experiments dealing with intentional forgetting. The results of the first experiment indicated that not attempting to recall items did not affect appreciably the later recall of these items. The second, third, and fourth experiments indicated that with blocked intra-serial cuing, the more processing allotted to an item, the more likely it was to be remembered. In the fifth, sixth, and seventh experiments, items were presented individually. They were then followed by a blank interval of time that could vary, and then the item's instruction appeared. It was found that final recognition for remember and forget items was positively related to the length of the interval, while final recall was not. In the eighth experiment it was found that implicit forget items were more likely than explicit forget items to be intruded in immediate recall, to be recalled during final recall, and to be recognized in a final recognition test. (DI)

Final Report

Project No. OE-172
Grant No. OEG-5-71-0023(509)

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THE EFFECT ON MEMORY OF INSTRUCTIONS TO FORGET

March, 1973

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

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Final Report

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Addison E. Woodward, Jr.

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The research reported herein was performed pursuant to a GRANT (grant or contract) with the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not therefore, necessarily represent official Office of Education position or policy.

PREFACE

This final report encompasses eight major studies. They are organized chronologically and topically, and are presented in a series of four papers. Each paper has its own introduction, method, result, and discussion section. Tables and figures within each paper are numbered consecutively. All references that have been cited are presented once at the end of the fourth paper.

In the first paper an experiment is reported which deals with the role of attempted recall of forget items and the later effect upon retention of these items. The second paper presents three experiments using blocked intra-serial cuing. The third paper also presents three experiments all attempting to manipulate the level of processing given to forget items. Finally, the fourth paper compares two intentional forgetting paradigms.

A number of students have worked under the auspices of this grant and deserve acknowledgment for their work. They include Robert Jongeward, Karen Seebohm, Denise Cortis, Patricia Tirone and Richard Phelps. All have profited tremendously from their work.

The first paper has already been accepted for publication by the Journal of Experimental Psychology. Parts of the second paper were presented at the Eastern Psychological Association Meetings in Boston in 1972. Parts of the third paper will be presented at the Eastern Psychological Association Meetings in Washington this spring, while the fourth paper will be presented at the Midwestern Psychological Association Meetings in Chicago this year.

ABSTRACT

Eight experiments dealing with intentional forgetting were completed during the period of the grant. Experiment I, "The Directed Forgetting of Individual Words in Free Recall", sought to define the role of recall and non-recall upon subsequent remembering of remember and forget items. The results indicated that not attempting to recall remember items did not affect appreciably the later recall of these items. Furthermore, attempting to recall forget items immediately did not affect later recall-ability.

Experiments II - IV, "Level of Processing in Directed Forgetting", departed from item-by-item cuing and instead used blocked intra-serial cuing. Such a procedure allowed the level of processing to be indirectly manipulated. The results of these experiments indicated that the more processing allotted to an item, the more likely it was to be remembered. Items closest in time to either recall or forget instructions were most likely not to be retained over the course of the experiment.

Experiments V - VII, "Directed Forgetting and Degree of Rehearsal in Free Recall", also dealt with rehearsal or processing of items but with a slightly different paradigm. Items were presented individually, were followed by a blank interval of time that could vary and then the item's instruction appeared. Recall of remember and forget items was examined as a function of this delay interval. The results of these experiments suggested in rather strong fashion that S̲s would not invest any rehearsal into an item until its instruction was seen. When S̲s were asked to reproduce the item (Experiment VII) after the interval, final recognition for remember and forget items was positively related to the length of the interval, while final recall was not.

Experiment VIII, "The Effect of Implicit and Explicit Instructions to Forget in A Directed Forgetting Paradigm", incorporated implicit and explicit instructions to forget within the same list structure. Since both paradigmatic procedures have been labeled examples of directed forgetting, it was the intent of this study to examine the fate of items followed by implicit forget instructions as opposed to the fate of items followed by explicit forget instructions. The results indicated vast differences between implicit and explicit forget items. Implicit forget items were far more likely to be intruded in immediate recall, recalled during final recall, and recognized in a final recognition test.

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THE DIRECTED FORGETTING OF INDIVIDUAL WORDS IN FREE RECALL

Recently, Woodward and Bjork (1971) introduced a paradigm designed to study how Ss remember some items in a free recall list and forget others. The paradigm involves cuing Ss to remember or to forget each item in the list in turn. To a remarkable extent, Ss are able both to recall the to-be-remembered words (R-words) and to avoid recalling the to-be-forgotten words (F-words.) From Woodward and Bjork's data, however, it is not possible to state conclusively whether the non-recall of F-words is attributable to their not being retrievable during recall or to their being actively suppressed.

The design of the Woodward and Bjork experiments included a delayed recall test at the end of the experiment during which Ss were encouraged to recall any word they could remember independent of the initial cuing of the word when it was presented. The delayed recall of F-words was very poor both relative to the delayed recall of R-words and in absolute terms. This finding was interpreted as evidence that the initial non-recall of F-words was not attributable to active suppression, in which case there should have been a sizable recovery in their recall on the final test. One problem with this interpretation is that the immediate recall of R-words might have contributed substantially to the likelihood that R-words were again recalled on the delayed test. Thus, the very large difference between the final recall of R-words and F-words might be due to their immediate recall and non-recall, respectively, rather than to their initial cuing.

Davis and Okada (1971) modified the Woodward and Bjork design to include an immediate test of the recall of F-words. Without forewarning, they asked Ss to recall all words, both R-words and F-words, from the last of a series of three 64-word lists. Davis and Okada found very poor immediate recall of F-words; in fact, in terms of average number of F-words recalled, there was an increase of less than one word over the number of F-words intruded in the recall of any one of the preceding lists.

Davis and Okada's results support the notion that low F-item recall is not due to active suppression of F-items, otherwise many more F-items would have been recalled on their immediate recall test; nevertheless, problems exist with their procedure. It is possible that the unexpected instruction to recall everything following the presentation of a last list is a disruptive event. The instruction comes as a surprise, it takes time, and it violates what Ss are told at the beginning of the experiment. Thus, such an instruction may disrupt Ss' recall attempts and lead to impaired performance. That such a disruption may occur is supported by an examination of the results of a free-recall experiment by Bruce and Papay (1970.) When they unexpectedly asked Ss to recall all the words in a last list, that is, to recall both the F-words preceding a forget signal in the list and the R-words following the signal, the serial position curve they obtained shows a clearcut disruption of the typical recency effect in the recall of the R-words. Another possible problem with a surprise test of F-item recall following the last list of an experiment is that recall performance on the last list, due to practice effects, proactive interference, or whatever, may not be characteristic of recall performance on other lists during the experiment. (For a discussion of the various procedures of testing F-items, see Bjork, 1972.)

Reitman, Malin, Bjork, and Higman (1971) devised a procedure that overcomes the objections that can be levelled at surprise tests such as the one used by Davis and Okada as well as the problems inherent in the kind of final test used by Woodward and Bjork to test Ss' memory for all items presented during an experimental session. The procedure involves forewarning Ss that one or more tests of F-items will occur during the experiment, that such tests will be indicated by a special signal, that they will be infrequent, and that the clearly best strategy is to forget F-items and to remember R-items. There are several advantages of the Reitman et al. procedure. A test of F-item recall can be inserted at any point during the experimental session and more than one such test can be included. Such tests do not come as a surprise, and to the degree that performance on the normal trials is comparable to performance when there are no tests of F-items, one has evidence that Ss are consistently trying to forget F-items and remember R-items.

The present experiment was designed both to provide a better estimate of Ss' memory for F-words immediately following the presentation of a list, and to assess the effect of the immediate recall of R-words on the subsequent recall of those words at the end of the experiment. Subjects were presented seven lists of 24 words. In all of the lists, Ss were cued whether to remember or to forget each word in turn; 12 words were forget-cued and 12 words were remember-cued in an intermixed fashion. In order to assess Ss' immediate memory for F-words, one of the seven lists was followed by a prearranged signal to Ss to recall all the words in the list independent of the cuing during the list. In order to assess the influence of immediate recall on the final recall at the end of the experiment, three of the lists were followed by a 30-sec. digit-shadowing task rather than a 30-sec. recall period. Thus, contrasting the final recall of words in lists followed by digit shadowing with the final recall of words in lists followed by an immediate recall test provides a measure of the extent to which final recall is facilitated by immediate recall.

Method

Subjects

The Ss were 40 undergraduates at the University of Michigan. They were paid $1.00 plus any bonuses that accrued from the payoff system employed in the experiment.

Materials and Apparatus

Every S viewed seven 24-word lists constructed of unrelated common four-letter nouns. The lists were shown on a high-speed (change time less than .05 sec) memory drum. The words, the cues to remember or forget, the instructions to recall or get ready for the next trial, and the digits to be shadowed all appeared in the same window. The timing of advances of the memory drum was controlled by a high-speed paper-tape reader reading a prepunched tape.

Design

After each successive word in a list, a colored (red or green) dot appeared as a cue to the S whether to forget or remember the item. For half the Ss a green dot meant remember and a red dot meant forget, and for the other half of the Ss the meaning of the colored dots was reversed. Each word was shown for 2.3 sec., and each cue was shown for 1 sec.

Three of the seven lists were followed by a 30 sec. recall period, three by a 30 sec. period in which digits were shadowed, and one list was followed by a special recall period during which Ss attempted to recall all list items independent of how they were cued in the list. The special recall list was always the fourth list seen. The remaining recall and shadow lists were randomly arranged together. Suitable counterbalancing techniques insured that, across Ss, all lists except the special list served in both the recall and shadow conditions. In addition, there were two different orders of presentation of the words in any one list. Finally, every quarter of each list contained three R-words and three F-words.

Procedure

Subjects were run individually. Every S was read a set of instructions and was shown two practice lists of 12 nonsense syllables. One practice list was followed by a recall period, the other by digit shadowing. After presentation of both practice lists, Ss were informed that a payoff system would be in effect during the experiment; they would receive a 1¢ reward for each R-word recalled during the immediate recall of a list, and they would lose 1¢ for each F-word recalled (intruded). Subjects were also told at this time of the special list; they were instructed that during the experiment a special list would occur, that they were to recall <u>all</u> words from that list, that the original payoff matrix would be suspended for the special list, and that they would receive 1¢ for any word recalled from that list whether or not the word was an R-word or F-word. The recall signal that designated the special list was the word "recall" highlighted in blue; all other recall signals were colored yellow. Finally, Ss were urged not to anticipate the occurrence of the special list, and they were told that the best strategy was to try always to forget F-items and remember R-items.

Each of the seven lists was preceded by a three-sec. ready signal. When digit shadowing followed a list, 13 eight-digit numbers appeared one by one at a 2.3 sec. rate. Subjects wrote down words they remembered on response sheets, one sheet per list, and after Ss had been presented all lists and had either shadowed digits or recalled list items, there was a phony debriefing period of two minutes following which Ss were asked, without having been forewarned, to recall all words they could remember from any of the lists they had seen. Subjects were informed at the time of the final recall that they would receive a 1¢ bonus for any word they recalled, independent of the initial cuing of the word. When the Ss could recall no more words, they were asked to circle any words among those they had recalled that they thought were F-words.

Results

Table 1 presents the immediate and final recall probabilities for R-words and F-words as a function of list type and [illegible]er. In immediate recall, Ss were proficient both at recalli[illegible] (nearly 60 percent) and avoiding the recall of F-words (less [illegible] 2 percent.) In response to the special recall instruction immediately following the fourth list, Ss were able to recall only about 5 percent of the F-words in the list. Thus, even when Ss were trying to recall F-words immediately and were rewarded for doing so, the average S was able to recall less than one of the F-words in the list. It appears that active suppression plays a negligible role in the immediate non-recall of F-words.

Several aspects of the final recall data merit comment. First, it is clear that the advantage of R-words over F-words in final recall is not attributable to their having a higher likelihood of being recalled immediately. The ratio of the final recall of R-words to the final recall of F-words is 6.6 (.240/.036) for IR lists and 6.7 (.175/.026) for NIR lists. Second, the final recall of both R-words and F-words from the special list corresponds exactly to the final recall of R-words and F-words from the other IR lists (.[illegible]0 versus .240, and .036 versus .035.) Finally, there is a list recency effect in the final recall of R-words across the seven lists, and the anticipation of such an effect was one motivation for having the special list always be the middle list of the seven lists presented.

In Figure 1 the probability of recall of R-words and F-words is shown as a function of time of recall (immediate in the lower panel; final in the upper panel,) serial position, and type of list. The notation IR(S) denotes the special list; that is, the list followed by a signal to recall all words in the list. The immediate recall of R-words from IR and IR(S) lists is very similar across serial positions, with the possible exception of positions 21-24. The immediate recall of F-words from IR and IR(S) lists is remarkably similar, especially in view of the fact that, from the Ss' standpoint, F-words recalled from IR lists are penalized intrusions and F-words recalled from the IR(S) list are in response to an instruction to recall such words and are rewarded. Only for F-words presented in positions 23 and 24 is the recall of F-words from the IR(S) list appreciable. The 20 percent likelihood of recalling F-words presented in those two positions probably represents retrieval from short-term memory and the Ss' efforts to retrieve F-words from short-term store may account for their less efficient retrieval of R-words presented at the end of the IR(S) list.

The final recall of R-words and F-words from IR and IR(S) lists was so indistinguishable that they are plotted together in Figure 1. Compared to the final recall of R-words and F-words from NIR lists, the final recall of IR and IR(S) lists is somewhat superior, but there appears

TABLE 1

Immediate and Final Recall Probabilities

List and Item Type	1	2	3	4[a]	5	6	7	Ave (1-3,5-7)
				Immediate Recall				
IR lists								
R-word	.642	.479	.554	.512	.517	.588	.567	.558
F-word	.025	.021	.017	.050	.017	.004	.013	.016
				Final Recall				
IR lists								
R-word	.170	.100	.134	.240	.188	.350	.500	.240
F-word	.038	.050	.033	.035	.025	.025	.046	.036
NIR lists								
R-word	.112	.100	.154	-	.176	.208	.300	.175
F-word	.042	.017	.017	-	.046	.013	.021	.026

Note - The notation IR denotes lists followed by an immediate recall, and NIR denotes lists followed by digit shadowing rather than an immediate recall. [a]The fourth list was always followed by a signal instructing Ss to recall all list items, both R-words and F-words.

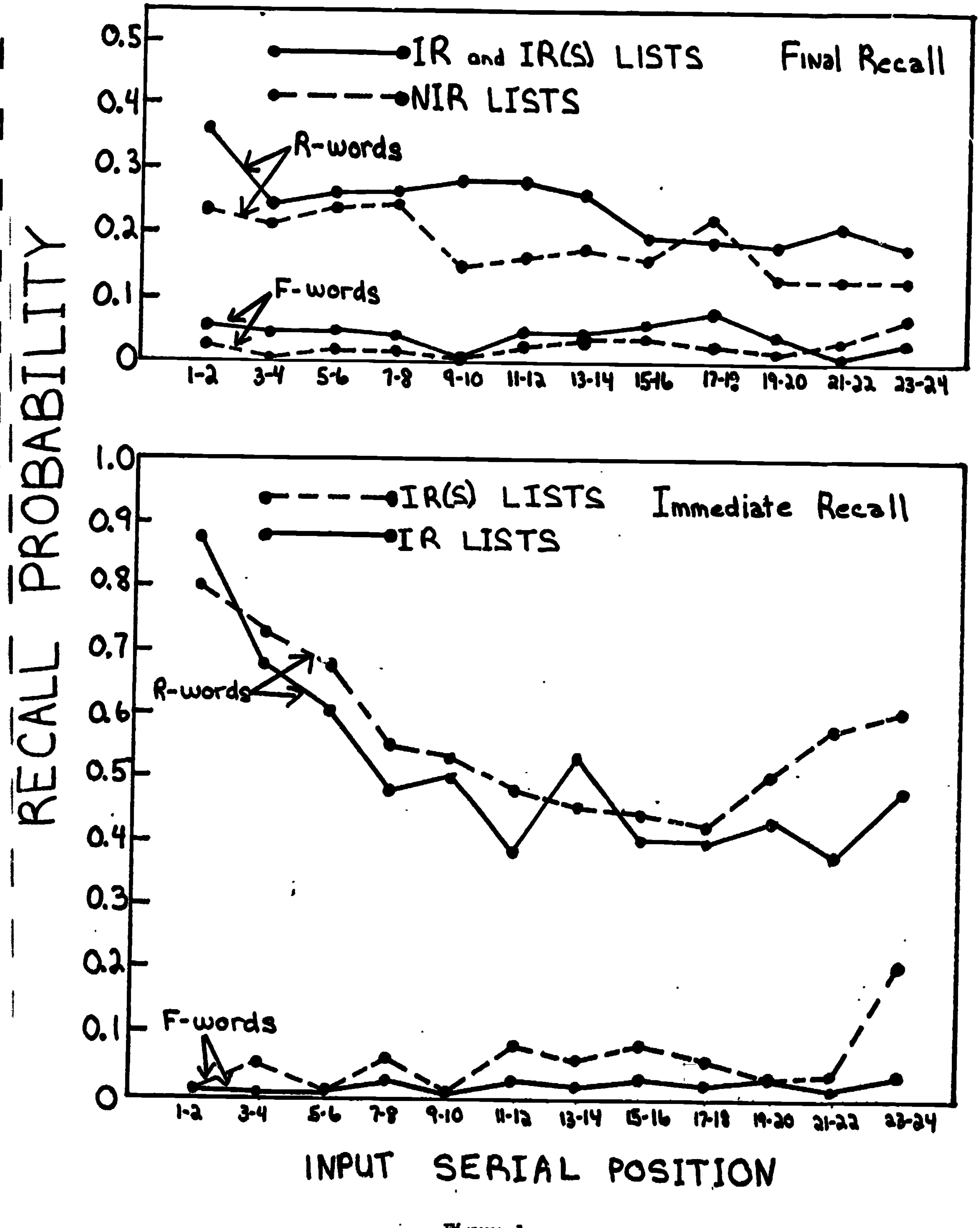


Figure 1

Immediate and Final Recall Probabilities as a Function of Serial Position.

to be no clearcut interaction with serial position.

It is worth pointing out that the two procedural innovations in the present study, that is, preinstructing Ss that there would be one immediate test of F-item recall and varying whether a list was followed by an immediate recall or digit shadowing, did not appear to influence the basic levels of R-word and F-word recall in comparison to Woodward and Bjork's (1971) initial results. For comparable lists, that is, those followed by an immediate attempt to recall R-words, the immediate and final recall probabilities are .502 versus .558 and .233 versus .240 for R-words, respectively, and .019 versus .016 and .047 versus .036 for F-words, respectively.

Discussion

Two questions prompted the current study, and the results answer those questions in an unambiguous way. First, the non-recall of F-words appears not to be explainable as arising from active suppression. The very poor performance on an attempted immediate recall of F-words in our study combined with the same result in Davis and Okada's (1971) study rule out active suppression as an important factor in the non-recall of F-words. Second, the superiority of final R-word recall over final F-word recall appears not to be attributable to the greater frequency with which R-words are recalled immediately. The final recall of R-words and F-words from lists that were not followed by an immediate recall reveals the same relative advantage of R-words over F-words as is shown in the final recall of words from lists that were followed by an immediate recall. These two results together argue that differences in immediate and final recall of R-words and F-words arise from differential processing during list presentation, rather than from differential editing of retrieval or output or from differential facilitation of delayed recall owing to differential frequency of immediate recall.

If Not Suppression, Then What?

The results of the present study taken together with the results obtained by Woodward and Bjork and by Davis and Okada argue convincingly against suppression as the mechansim that underlies the non-recall of F-words. It is worth noting that two different suppression mechanisms are ruled out: Subjects might retrieve F-words during tests of immediate recall, but reject them because they are tagged as F-words, or they might suppress retrieval from the entire set of F-words in memory. The latter kind of suppression might occur if F-words were retrievable from memory, but were functionally segregated from R-words in memory by virtue of the differential rehearsal and interassociation Ss devote to R-words. In any case, the negligible immediate recall of F-words when Ss are trying to do so is evidence against any brand of output suppression.

A relatively simple and straightforward possibility is that F-words do not exist in memory at the time of an immediate recall. Although the procedure forces Ss to read every word as it is presented because the cue to remember or forget is not presented until after the offset of each word, F-words may be lost from memory at a rapid rate characteristic of unrehearsed items. The very few F-words Ss are able to recall immediately may consist entirely of (a) words mis-encoded as R-words, (b) words that have a strong idiosyncratic significance for a particular S, or (c) words still retrievable from short-term memory because they were presented in the last serial position or two in the list.

The possibility that F-items do not exist in memory has been completely discredited in other directed-forgetting paradigms for the very good reason that certain kinds of recognition and recall tests provide ample evidence that F-items exist in memory (for a review of the evidence, see Bjork, 1972). In the present experimental context, however, which involves item-by-item cuing rather than the cuing of sets or blocks of items, part of the non-recall of F-words may be attributable to their simply not existing in memory. In the case where Ss are cued only after a block of items that they are to forget these items, they are forced to rehearse and interassociate F-items to a much greater extent than they are in the present procedure.

That the loss-from-memory explanation of the non-recall of F-items may be part, but not all, of the answer is suggested by some results from the Woodward and Bjork and Davis and Okada experiments. Davis and Okada included in their design a recognition test for R-words and F-words. They found the recognition of F-words to be clearly inferior to the recognition of R-words, a result that supports the possibility that F-words are lost from memory to some extent, but they also found the recognition of F-words to be very much higher than the false-alarm recognitions of words never presented, a result that clearly implies F-words are not completely lost from memory. Woodward and Bjork found, using categorized lists, that the recall of a given F-word was facilitated if R-words from the same semantic category were presented in the list, but, again, F-word performance was clearly inferior in all cases to R-word performance.

The most plausible explanation, in our opinion, is the following: During the presentation of a list, Ss rehearse and interassociate R-words to the extent that the presentation sequence provides time to do so; they try to avoid any rehearsal or interassociation of F-words. This differential treatment of R-words and F-words results in R-words being grouped as a set in memory distinct from F-words and words never presented. Whether a word exists in long-term memory, as measured by a recognition test, depends on its receiving a certain minimal amount of rehearsal, Some F-words are rehearsed that much, some are not; nearly all R-words are rehearsed more than the minimum necessary to support their recognition. Retrieval from long-term memory, as measured by a recall test, is almost entirely a function of interassociation. Thus, R-words are retrievable to the extent that they are interrelated in memory; F-words are typically not retrievable unless an experimental manipulation or idiosyncratic happenstance leads to interassociations or associations with R-words.

LEVEL OF PROCESSING IN DIRECTED FORGETTING

Upon seeing an item in a memory task, the typical S begins some form of rehearsal. The item, according to various two-store theorists (Atkinson & Shiffrin, 1968), will reside in the short-term store temporarily, will accrue rehearsal time, if it is a member of the set of items currently in the rehearsal buffer, and, with some probability, depending upon the time spent in the STS, will be transferred successfully to long-term store. Other memory theorists (Craik & Lockhart 1972), who wish to move away from store notions of memory, talk in terms of level of processing. Processing is viewed as a continuam from light or superficial to deep. Presumably, the deeper the processing the more likely the item is recalled.

In any case, it appears that the intentional forgetting paradigm is an ideal vehicle to study either time spent in the short-term store or the level of processing.

Past results indicate that Ss invest only the barest minimum of rehearsal to items which may be followed by a forget instruction and, if an item is followed immediately by a forget instruction, further rehearsal or processing stops altogether. Some way is needed, however, to manipulate rehearsal activity prior to the instruction. Efforts to do this, to "coerce" Ss into rehearsing items that may later be followed by a forget instruction have not been entirely successful. (See Woodward & Bjork 1971) Such attempts have used item-by-item cuing and various delay intervals interposed between the item and its instruction. Viewing rehearsal then, or processing, as a continuam, the problem seems to be one of developing a procedure which will allow us to manipulate the amount of rehearsal along this continuam before either a remember or forget instruction will appear. It seemed that one way to do this was to move from item-by-item cuing to blocked intra-serial cuing much like Bruce and Papay's procedure (1971).

In the first experiment to be reported, Ss saw list of items numbering either 2, 4, 8, or 12, then either a recall instruction (recall the items you just saw) or a forget instruction (forget the items you just saw). Following each forget instruction were twelve additional items for subsequent recall. We expected that items closest in time to the forget instruction would most likely not be recalled in the final recall test nor intruded in the immediate recall test. Items nearest in time to the recall instruction were expected to be recalled, at least immediately with higher recall probability, than items farther away from the instruction.

Method

Subjects. Sixty Ss, drawn from the University of Michigan summer subject pool, participated in this experiment. They were paid $1.00 plus any bonuses that accrued from the payoff system employed in the experiment.

Materials and Apparatus. Every S viewed nine variable length word lists. The words were all common four-letter nouns. After each list there was a recall period and, after all nine lists were presented and recalled, 18 Ss were given a final recognition test, and 42 Ss were presented with both a final recall test followed by a final recognition test.

The apparatus was a high-speed (change time less than .05 sec.) memory drum. The words, the cues to forget or remember, and the instructions to recall or get ready for the next trial all appeared in the same window. The timing of advances of the memory drum was controlled by a high-speed paper tape reader reading a pre-punched tape.

Design. Nine lists were presented individually to the Ss. The exact nature of the lists was the main independent variable of the experiment. Lists were 2, 4, 8, or 12 items long and were followed by either a recall instruction or a forget instruction. In the latter case, 12 additional items were seen followed by a recall signal. A ninth list was used for control purposes. It began with a forget instruction, was followed by 12 items and then a recall signal. We reasoned that Ss might not fully process items until a forget signal had been seen. Therefore, differences favoring the control list over the 12 item remember list would indicate less efficient processing on the part of the Ss. The implication, then, might be that remember items differed from forget items both in instruction and in processing.

Three different list orders were used by randomizing both words and conditions. In addition, by simple interchanging, all F-items served in the corresponding R-word list condition and vice-versa. Thus, if two words were followed by a forget instruction for one S, they were followed by a recall signal for some other S. Likewise, the 4F, 8F and 12F lists for one S were 4R, 8R and 12R lists for another S. This counterbalancing was intended to minimize item effects. List position effects were particularly counterbalanced by the randomization procedures described above.

Procedure. Subjects were run individually. Each S was read a set of instructions and was shown four practice lists of nonsense syllables representing the experimental conditions to be encountered. After the practice lists, further questions about the experiment were answered, and then the experiment proper began.

Each of the lists was preceded by a 3 sec. ready signal. All items were seen for 1 sec. as was the forget instruction. The recall signal was in view for 30 sec. during which time the S was to write down as many of the words to be remembered as he could. One could best characterize the S's strategy by saying he was to remember all items unless otherwise instructed.

After recall of the last list, there was a debriefing period lasting several minutes, and then Ss were either asked to recall all of the items just seen or were given a recognition test including all of the items from the experiment plus an equal number of distractors (112). The forty-two Ss who received the final recall test were then given the final recognition test.

All Ss received $1.00 plus 1¢ for each item recalled during the final recall period and 1¢ for each correct recognition and minus 1¢ for each false alarm during the recognition test. The Ss task on the recognition test was to circle any item, R or F, previously seen during the experimental session.

Results and Discussions

Tables 1 and 2 present the main results of the experiment. Data in Table 1 indicate that the forget instruction was effective in the sense that R-word recall was little affected by the presence or number of preceding items that were to be forgotten. Subjects recalled 45% of the R-items when no F-items preceded the to-be-remembered list. The control list, which began with a forget instruction, then 12 items to be remembered, yielded 44% recall. Since no difference exists between control list recall and 12R recall (44% vs 45%) it would appear that Ss are processing effectively all items up to the first instruction. We feared that the experimental task might indirectly influence a S's rehearsal strategy such that Ss might haphazardly rehearse the first set of items deciding that 50% of the time these items would be instructed forget, but the last set of items always would be instructed remember or recall. The data indicate that our fears were unnecessary.

Final recall data from Table 1 suggest that the effectiveness of the forget instruction was not limited to immediate recall. Although the data are variable, there appears to be no consistent effect of the number of prior F-items upon recall of the remember word sets. This seems paradoxical since Ss did recall a number of F-items finally (see Table 2). Thus, through output interference alone one might have expected some interference effects from F-items.

The set differentation notion, proposed by Bjork, is consistent with this data, even when F-items are not forgotten, no interference results. If Ss can differentiate between two sets of items, then it is entirely consistent that one set of items can still be in memory yet not interfere with another set of items also in memory.

The probability of recalling F-items immediately (see Table 2), although low, increased with the number of forget items in the set. The reverse was true for R-items, where probability ranged from 1.0 for a 2R-item set to .45 for a 12-item set. Final recall of R-items seemed to increase with set size and ranged from .10 to .24, while F-item recall decreased slightly.

The most striking aspect of the data is the comparison between final F-item recall and corresponding R-item recall. Consider the probability of recall for the 2R and 4R conditions opposed to the 2F, 4F conditions. Conservatively, a situation exists in which F-item recall is equivalent to R-item recall, an unusual finding in light of past studies where recall for R-items has been found to be vastly superior to that for F-items (Woodward and Bjork, 1971).

TABLE 1

Probability of Remember Word Recall as a Function of Length of Forget Word List and Time of Recall

Length of Forget Word List	Time of Recall	
	Immediate	Final
0F	.44	.18
2F	.50	.24
4F	.49	.27
8F	.42	.16
12F	.41	.18

TABLE 2

Probability of Recall as a Function of List Length, Instruction and Time of Recall

	Time of Recall			
	Immediate Recall		Final Recall	
List Length	Remember	Forget*	Remember	Forget
2	1.0	.05	.10	.18
4	.91	.10	.17	.20
8	.59	.08	.16	.16
12	.45	.08	.24	.14

*These figures really represent F word intrusions, since Ss were not instructed to recall these items.

Table 3 presents final recognition data for R and F-items as a function of list length. Because no consistent differences exist between Ss receiving only the final recognition test and Ss receiving the recall test first followed by the recognition test either in recognition rate or false alarm rate, the latter being .086 and .091 respectively, recognition data for all Ss have been combined. Subjects are more able to recognize R-items than F-items, but more important than the slight differences between these recognition rates is the striking similarity that does exist.

Table 4 presents the probability of correctly recognizing R-items as a function of the number of prior forget items. These data reinforce the corresponding recall data and show that the F-instruction was effective in eliminating interference from the to-be-forgotten items.

Finally, Figure 1 presents the probability of recall as a function of distance from the instruction; either forget or recall. I-1 represents the item just prior to the instruction, I-2 the second item before the instruction and so on. As one moves away from the instruction, the number of observations per point decrease. Clearly, several different trends exist depending upon the nature of the item and the time of recall. Immediate recall of R-items exhibits the usual serial position curve obtained with such tasks. Final recall of R-items demonstrates the now well documented negative recency effect (Craik, 1970; Bjork, 1970) Immediate recall of F-items increases slightly as a function of the item to instruction interval as does final recall. Final recall of F-items was higher than immediate recall.

Experiment II

A second study was conducted to explore the unusual finding that final F-item recall was in some cases superior to R-item recall. Subjects saw 1, 2, 3, or 4 items, then either a recall instruction or a forget instruction. The forget instruction was always followed by 12 additional items to be remembered. The rationale for limiting the subset size to 4 items was that, in the first study, the effect was largest with the 2 and 4 items subsets.

Method

Subjects. Thirty-six students drawn from introductory psychology classes at Albion College volunteered for the experiment.

Materials and Apparatus. All Ss viewed 18 variable length word lists. The words were of the same type used in Experiment I. After each word list there was a recall period, and after all 18 lists, a final recall period. The apparatus was the same used in Experiment I.

Design. Lists were 1, 2, 3, or 4 items long. Either a recall instruction or a forget instruction followed a list. In the latter case, 12 additional items were seen and followed by a recall signal. In addition to these 8

TABLE 3

Final Recognition of R and F-Items as a Function of List Length

	Item	
List Length	Remember	Forget
2	.566	.542
4	.667	.546
8	.562	.467
12	.617	.521

TABLE 4

Final Recognition of R-Items as a Function of the Length of the Preceding F-Word List.

Length of F-Word List				
0	2	4	8	12
.531	.628	.654	.579	.567

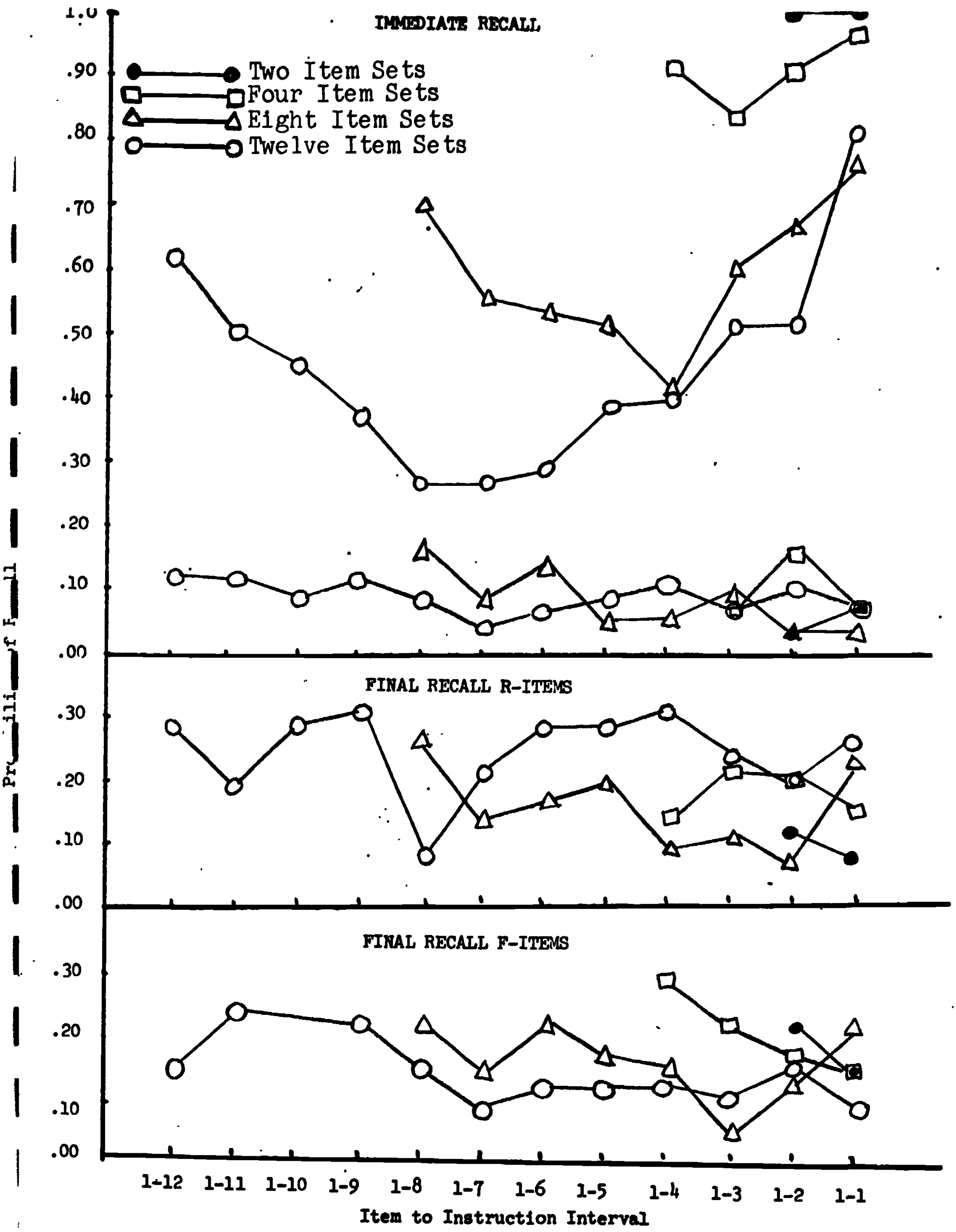


Figure 1

Probability of Recall as a Function of Distance from the Instruction (Forget or Recall), Time of Recall, Type of Item.

lists, a ninth was included for control purposes and consisted of 12 words preceded by no F-items. The list was intended to evaluate the presence or absence of interference effects resulting from inclusion of F-items on other lists. A set of nine lists composed the first replication, the second nine, the second replication.

Elaborate control and counterbalancing techniques were used to insure that all F-items served in the corresponding R-word subset condition and vice-versa. In addition, across Ss each list type was seen in each list position only once, a situation not met in Experiment I.

Procedure. The procedure was the same as that used in Experiment I except no final recognition test was given. Furthermore, Ss were not paid in this experiment but tried to accumulate points. Subjects were given one point for each R-word immediately recalled and penalized a point for each F-item recalled. Subjects earned a point for each item, either R or F, recalled finally.

Results

The results of this experiment can be seen in Tables 5 - 7. Once again the forget instruction was effective (see Table 5) in the sense that interference from the F-item on subsequent recall of an R-item set was eliminated. The probability of recalling 12 R-items not preceded by any F-items was .48. The probability of recalling 12 R-items preceded by 1F, 2F, 3F, or 4F subsets was respectively .41, .46, .50, and .41. Final Recall of R-items was also not influenced by the number of prior F-items.

Immediate recall of F-items, although low, increased with set size (see Table 6.) Final recall of these items was higher than immediate recall with one exception, the 3F condition. Immediate recall of R-items from subset sizes of 1 - 4 was, as expected, near perfect. Final recall of these same items dropped by a factor of 10, and was equal to final F-item recall.

Table 7 presents the probability of recall as a function of subset size, instruction, time of recall, and distance from the instruction. Immediate and final recall of F-items increased as a function of the distance between the item and its instruction, as did final recall of R-items. Immediate recall of R-items remained relatively stable over the small range of instruction to item distances sampled in this experiment.

Discussion

Effectiveness of forget instructions measured in terms of the probability an S will be able to recall F-items during final recall depends upon the processing allotted to the item. The earlier an item appears relative to its instruction, the more processing it is assumed to receive and the more likely it will be recalled. These results are consistent with the short-term store/rehearsal buffer notions as well as more recent

TABLE 5

Probability of Remember Word Recall as a Function of Length of Forget Word List and Time of Recall

Length of Forget Word List	Time of Recall	
	Immediate	Final
1F	.41	.10
2F	.46	.14
3F	.50	.12
4F	.41	.13

TABLE 6

Probability of Recall as a Function of List Length, Instruction and Time of Recall

	Time of Recall			
	Immediate Recall		Final Recall	
List Length	Remember	Forget*	Remember	Forget
1	.986	.014	.097	.055
2	1.00	.049	.083	.062
3	.986	.088	.083	.051
4	.938	.069	.118	.094

* These figures really represent ~~F word intrusions~~, since Ss were not instructed to recall these items.

TABLE 7

Probability of Recall as a Function of Item Type, Time of Recall and Distance From Instruction

List Type	Distance From Instruction			
	I-4	I-3	I-2	I-1
Forget	Immediate Recall			
1F				.014
2F			.056	.042
3F		.111	.083	.069
4F	.097	.083	.069	.028
AVE	.097	.097	.042	.038
Remember				
1R				.986
2R			1.00	1.00
3R		1.00	.972	.986
4R	.958	.917	.958	.917
AVE	.958	.958	.977	.972
Forget	Final Recall			
1F				.056
2F			.083	.042
3F		.056	.042	.056
4F	.125	.111	.069	.069
AVE	.125	.083	.065	.056
Remember				
1R				.097
2R			.083	.083
3R		.111	.097	.042
4R	.139	.083	.125	.125
AVE	.139	.097	.102	.087

theorizing about the level of processing (Craik & Lockhart, 1972.) When an instruction occurs after an item then, in effect, processing stops for that item. Relative to other less recent items, the most recent item is short changed in terms of processing time. This instruction may be either a forget instruction or a recall signal.

The next point to be made depends upon the generality of these studies. If one can generalize to the work reported by Bruce and Papay (1970), Epstein (1969) and others (Elmes, 1970) the present results show it is entirely possible to obtain no interference effects as a result of the forget instruction and yet still find F-items in memory. Both studies reported here indicated no consistent interference effects either immediately or finally from items to be forgotten. The absence of interference effects, then, cannot be due to the absence of F-items in memory.

Finally, your attention should be directed to the apparent paradox presented by the data. In Experiment I final F-item recall was, in some instances, better than final R-item recall. In Experiment II final F-item recall was essentially equivalent to final R-item recall. One could suggest that neither experiment maximized the opportunity to achieve higher final recall of F-items than R-items. For instance, all F-item subsets were followed by 12 R-items, while all R-item subsets were followed by 30 secs. of recall. The recall periods surrounding the R-items may somehow have made them temporarily more distinct than F-items, which were always surrounded by other items. In addition, in Experiment II, Ss saw 18 lists or a total of 160 words. This may have led to depressed final recall figures, perhaps more so for F-item subsets than R-item subsets. Nevertheless, the fact that R-item immediate recall can be near perfect for small subsets and no better than final F-word recall is amazing. R-words have actually been seen twice, once at input and once at output. Furthermore, Ss have had the opportunity to reproduce them once. F-items are seen once only, and are only rarely recalled immediately. Yet final recall for R and F-items is quite equivalent. One reasonable explanation for this effect would suggest that differential rehearsal accrues to items in the rehearsal buffer as a function of the distance between the item and the recall or forget instruction.

The fact that final F-item recall is equivalent to final R-item recall clearly demonstrates the negligible effects of output upon long-term memory. Possibly, output is beneficial to long-term memory only if the item recalled came from long-term memory. If the item is currently in short-term store, successful output does not guarantee long-term retention. In at least this experimental situation the recall signal was as effective a forget cue as the forget instruction.

Experiment III

Experiment I, in some instances, indicated higher final F-word recall than corresponding R-word recall. Experiment II did not confirm these findings. Experiment III was undertaken to overcome some of the methodological objections that could account for poorer final F-item recall in

Experiment II. Specifically, Experiment III was designed to make F-item subsets more equivalent to R-item subsets. In Experiments I and II, R-item subsets were followed by 30 secs. of recall, while F-item subsets were followed by 12 additional R-items. It was argued that the recall periods surrounding R-item subsets may have made them more temporarily distinct than their F-word counterparts, and thus more recallable during the final recall period.

In this experiment, F-item sets were made more equivalent to R-item sets by inserting a 15 sec. period between presentation of the last F-word and the first R-word. This 15 sec. period was the length of the recall period which followed the last R-word and separated it from the subsequent R-word set.

Subjects were presented two sets of words in each list. The first set's (List A) length varied and could be 2, 4, 8, or 12 items long. Next followed either a recall or a forget instruction. The second set's length (List B) was fixed at 12 items and was always followed by a recall signal.

In addition to attempting to replicate the results of Experiment I by making R and F-item sets more similar, Experiment III should allow us to make a direct unconfounded comparison between the recall instruction and the forget instruction. The only difference between the instructions now is in the attempted recall of R-items. This comparison could not be made in either Experiment I or Experiment II and it leads to the following question: "Are the instructions equally effective in reducing interference on List B items?" That is, will List A items followed by a forget instruction be more likely to intrude in recall of List B and thus cause interference, than List A items followed by a recall instruction?

Method

Subjects. Fifty-six Ss were drawn from the University of Michigan summer subject pool. They received $1.30, plus any bonuses earned for their final recall performance.

Materials and Apparatus. Each S viewed eight pairs of lists. The words were four-letter common English nouns. After the first list of each pair a recall or forget instruction appeared, its duration being 15 secs. After the second list of each pair a recall signal appeared, its duration was 30 secs. Each list began with a 2.0 sec. ready signal, and each item was seen for 2.0 secs. Words were typed on 2 by 2 slides and presented by a Kodak Carousel Slide Projector.

Design. The first list in each pair varied in length and could be either 2, 4, 8, or 12 items long. The second list in each pair was always 12 items long and was followed by a recall period. Either a recall instruction or a forget signal followed the first list. Four levels of list length combined with two types of instructions necessitated the use of eight pairs of lists. After recall of the last list of the last pair, Ss were administered a final recall test.

Fifty-two words were randomly divided into two-word lists, two four-word lists, two eight-word lists, and two twelve-word lists. These lists were the A lists. One list of each length appeared in the first four-list pairs and one list of each length appeared in the second four-list pairs.

The first list of each pair, List A, was shifted four times across Ss. As a result, the second list of each pair, or List B, was preceded equally often by each List A length. Accompanying each shift was a re-randomization of the 52 A-items. The intent of these manipulations was to minimize specific item effects, and to control for list position effects.

In addition to the controls just described, any List A that was a recall list for one S was a forget list for another S, and vice versa. This instruction reversal times the four shifts previously described necessitated eight different groups of Ss. Seven different Ss were run in each group, 56 in all. The net effect of all control procedures was to counterbalance against list position effects.

Procedure. Subjects were run in groups of two-four. The E read a set of instructions describing the events to be encountered. The list pair structure of the experiment was mentioned including a statement about the variable length of List A and the fixed length of List B. The forget signal was described as a dark blue slide while the recall signal was a row of asterisks. Subjects were instructed that recall meant free recall. Finally, subjects were informed that the best strategy was to try always to remember each word unless told specifically otherwise. Two practice lists of nonsense syllables were shown to the subjects.

At the end of the experiment, E asked each subject to recall all items from the session, R as well as F items. At this point, it was mentioned that each word recalled, regardless of its former instruction, would earn one cent for the subject.

Results

Table 8 presents the probability of recalling set B items as a function of the time of recall, instruction for Set A, and Set A length. The data are noteworthy because of the absence of an effect either of instruction or list length. Set B recall does not depend upon either Set A size or whether Set A was followed by a recall instruction or a forget instruction. Interference from Set A to Set B does not seem to increase as a function of Set A size, and, in addition, the recall signal following Set A is an effective a reducer of interference as a forget instruction. Final recall, although substantially lower than immediate recall, supports the above statements.

Figure 2 emphasizes clearly the lack of effect of Set A instruction upon the immediate or final recall of Set B. It shows the probability of

TABLE 8

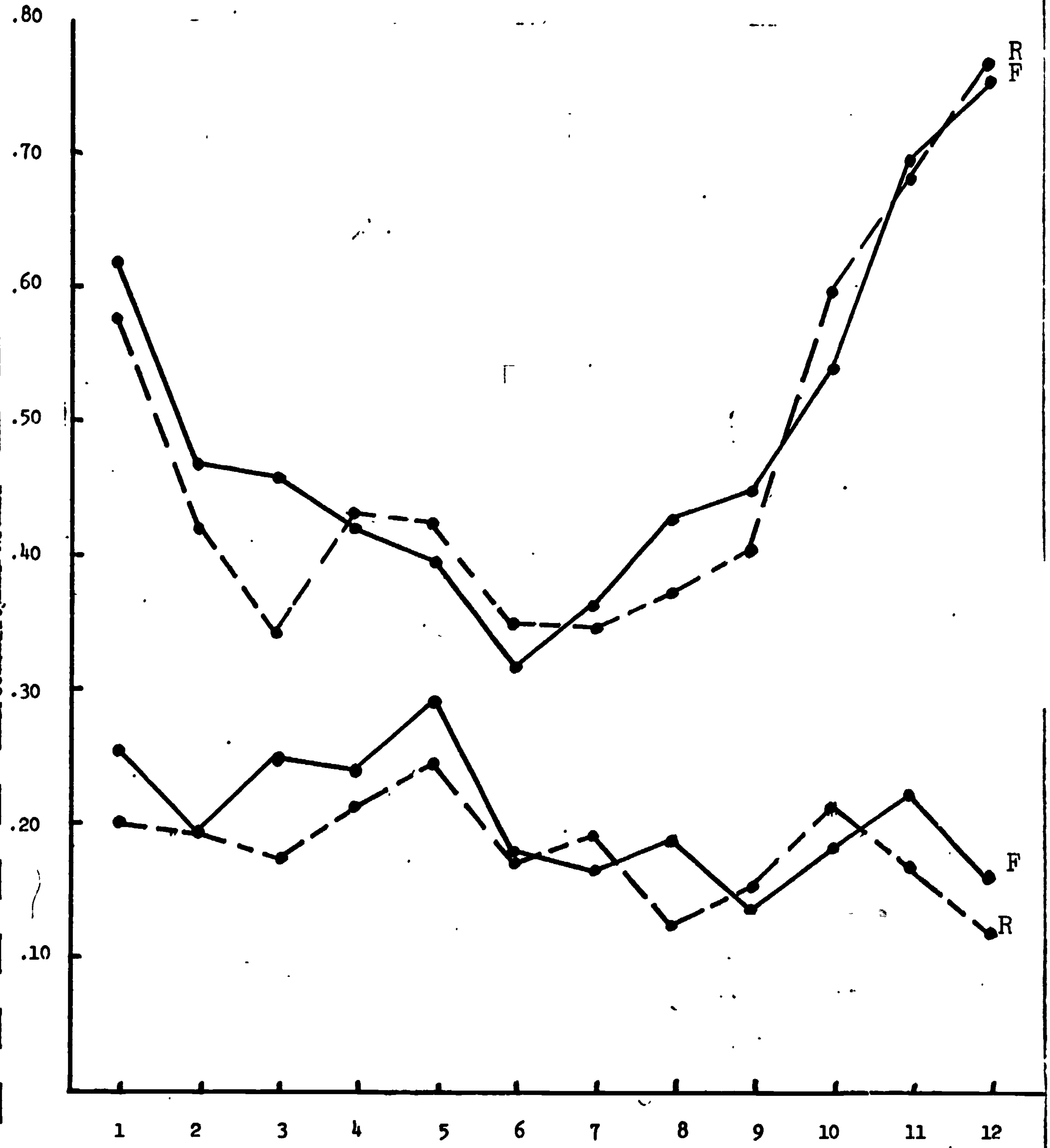
Probability of Recalling Set B Items as a Function of Set A Length, Time of Recall and Set A Instruction

No. of Items in a Set	Immediate		Final	
	Forget	Remember	Forget	Remember
2	.521	.496	.219	.216
4	.484	.484	.196	.170
8	.449	.438	.189	.164
12	.484	.455	.201	.159

TABLE 9

Probability of Intruding a Set A Item into Set B Recall as a Function of Set Instruction and Set A Length

No. of Items in Set A	Remember	Forget
2	.107	.063
4	.036	.067
8	.045	.065
12	.019	.033



Input Position

Figure 2

Probability of recall of Set B items as a Function of Set A Instruction, time of Recall and Input Position.

recall of Set B items as a function of serial position and Set A instruction. Immediate recall of Set B items yielded typical serial position curves, with no difference occuring as a function of Set A instruction. Final recall of Set B items yielded the characteristic negative recency effect, with again no difference attributable to Set A instruction.

Table 9 presents the probability of an intrusion of a List A item into List B recall as a function of the length of Set A and the instruction following Set A. Intrusion rates in general were low, and except for the two-item set followed by a recall instruction, did not vary as a function of set size. No differences existed in intrusions between items followed by an F-instruction or an R-instruction. These data support further the data reported in Table 8. That is, the intrusion rates themselves, a possible index of interference, do not reflect differences between R and F-item sets or List A length.

Table 10 presents the probability of Set A recall as a function of instruction and Set A length. Immediate recall of R-items decreased as a function of set size. The intrusion rate for F-items was invariant with set size. Final recall of R-items decreased in some instances by a factor of 5, and was substantially lower than immediate recall. Final recall of F-items increased by a factor of two, but remained less than final R-item recall. No consistent differences occurred as a function of list length in final recall of R or F-items.

Discussion

Both Experiments II and III were undertaken to explore the unlikely finding that final recall of F-items was, in some instances, equivalent if not better than final recall of R-items. In a strict sense, the results of Experiment I were not replicated. On the other hand, no set of experiments to date has found such consistently small differences in recall probability between items that were to be forgotten and items that were to be remembered.

Why differences between recall of F and R-items were so small in final recall, yet so large in immediate recall, needs explanation.

One explanation would stress the fact that in these experiment manipulations to force subjects to rehearse all items equally were successful. Upon encountering an item, subjects did not know whether it would belong to an R-word set or an F-word set. He had to rehearse all items and the rehearsal given them was the kind probably given to any item in a free recall task. That is, inter-item associations and other retrieval aids were developed. Such associations fostered by rehearsal made F-items resistant to forgetting, at least more so than in past studies which incorporated item-by-item cuing. Item-by-item cuing allowed subjects to avoid processing an item until its instruction appeared. In these experiments subjects simply could not adopt that strategy and expect to perform well.

TABLE 10

Probability of Recalling Set A Items as a Function of Set A Length, Set A Instruction and Time of Recall

No. of Items in Set A	Immediate		Final	
	Remember	Forget	Remember	Forget
2	.991	.063	.188	.134
4	.902	.067	.161	.112
8	.614	.065	.214	.121
12	.445	.033	.179	.125

The data from all three experiments consistently raise questions about the generality of the list length law (Murdock, 1960.) This law asserts that probability of recall will be inversely related to list length. However, subjects are as likely to recall finally items (R or F-items) from a twelve-item list as they are a two-item list. Data supporting this statement are present in Tables 2, 6 and 10. Table 3 presents recognition data also in support of the statement. One exception to the violation exists and that is the final R-word recall data in Table 2.

These experiments also suggest that a recall instruction can be as effective a forget instruction as a forget instruction. This effectiveness can be measured in terms of interference effects, or a lack of the same which exist in all these experiments. The fact that F-item sets and R-item sets in Experiment III did not interfere with their corresponding list B's, points to the importance of Bjork's set differentiation idea (1970), one of the processes of a two-process theory developed to explain directed forgetting. According to Bjork, subjects are able to differentiate, to form two distinct item sets in memory, and to keep them distinct from each other. In immediate recall, subjects refrain from recalling items from the F-set. In final recall, where no such restrictions are imposed upon them, subjects are able, to the extent they have rehearsed F-items, to recall items from the F-items set. Bjork's set differentiation idea is also consistent with a paradox presented by the data. In these studies there appears, on the one hand no interference from F-items, yet on the other hand F-items clearly exist in memory. It is intuitively reasonable and consistent with Bjork's notions to envision two distinct sets of items in memory, encoded differently and in such a way that will not interfere with the recall of the other.

DIRECTED FORGETTING AND DEGREE OF REHEARSAL IN FREE RECALL

The idea that a cue to forget should be less effective the longer an item has been studied or rehearsed is as compelling as the idea that learning should be an increasing function of study time. After all, the longer an item has been rehearsed, the more likely it is learned, and the less likely it should be forgotten. In recent studies, however, this compelling notion has not been supported (Woodward & Bjork, 1971; Davis & Okada, 1971.) This paper explores in some detail the limits to which Ss' ability to forget items is independent of processing time.

In their first experiment Woodward and Bjork manipulated directly the length of time R and F-items were in view. Lists were 24 items long, 12 items were individually cued remember and 12 items were individually cued forget. Items could be viewed for 1, 2, or 4 seconds before the instruction. The reason for manipulating presentation time was to assess whether a forget signal would become progressively less effective the longer a word was shown before the signal. The results indicated that R and F-word recall did not vary as a function of presentation time despite the expectation of greater recovery of F-words in final recall with increasing presentation time.

Davis and Okada (1971) introduced a one-second delay between the item and its instruction to increase rehearsal for all items and thus make F-items more difficult to forget. Subjects would have to keep items in mind for an extra second before they could act in accordance with the instruction. No differences were found between recall of F and R-words followed by a delay as opposed to no delay.

From these results, it would seem that presentation time or processing time has no effect on R and F-item recall in the context of a free recall paradigm. However, Woodward and Bjork's (1971) manipulation of presentation rates have at least one methodological flaw, while Davis and Okada (1971) simply did not sample enough delay intervals to warrant such a conclusion. Subjects in the Woodward-Bjork study reported that they did not try to do anything with a word during its presentation beyond keeping it in sight. If a signal occurred designating the current word to be an R-word, they tried to rehearse it or relate it to other R-words, otherwise they disregarded the item entirely. In other words, Ss were not using the time available to them to rehearse the current item, rather they rehearsed other less recent R-words while the current item was in view.

The present experiments attempt to overcome the paradigmatic flaws inherent in Woodward and Bjork's (1971) study. Following the procedure of Davis and Okada (1971), a variable interval was introduced after every item and before each instruction. This interval, or cue delay period varied from functionally 0 to 12 seconds. It was assumed that Ss would rehearse the most recent item during the cue delay period. We hypothesized the longer the cue delay, the harder it would be for Ss to forget F-items and the easier it would be to remember R-items. That is, Ss must be able to remember an item in order to either forget or remember it, depending upon the item's instruction. It should be emphasized that during the cue delay period neither the item nor its instruction could be seen. From the S's viewpoint, the item had already been presented and, if he were to act upon the item in accord with the instruction which was yet to be presented, he would simply have to remember the item during the cue delay period. This procedure overcomes the main objection to Experiment I reported by Woodward and Bjork (1971.) In their study, Ss did not have to process the current item since it was in view. In this study we assumed Ss would find it necessary to process the current item since it was in view for only a short period of time.

The more general intent of the research here is to provide an answer to the question, "Can Ss intentionally forget items that have been learned or at least processed more than superficially?" To date, two methods exist for determining the effectiveness of forget instructions. (See Bjork In Tulving & Donaldson, 1972.) The first method assumes that if items are in memory, that is not forgotten, they should provide interference with other items that are in memory. Admittedly this is a rather weak measure of forgetting in that it is possible to have a set of items in memory, which do not interfere with some other set of items. (Woodward & Bjork, 1971) A second method provides a more direct measure of the ability of Ss to forget items. At some date later than presentation of F-items Ss are simply asked to recall F-items (Woodward & Bjork, 1971; Bjork & Woodward, 1972.) If Ss cannot recall the F-items, then they are said to be forgotten. It is in this latter sense that the phrase "intentionally forget" is used.

Method

Subjects. Forty-eight Ss drawn from the University of Michigan summer subject pool participated in this experiment. They were paid $1.00, plus any bonuses that accrued from the payoff system employed in this experiment.

Materials and Apparatus. Every S viewed four 36-item lists. The items were all common four-letter nouns. Each list began with a 3 sec. ready signal and ended with a 30 sec. recall instruction. Eighteen randomly selected words were followed by remember instructions, 18 words by forget instructions. In each third of the list 6 R-words and 6 F-words were presented. The apparatus employed was a high speed memory drum (change time less than .05 sec.) The words, the cues to forget or remember and the instructions to recall or get ready for the next trial all appeared in the same window. The timing of advances of the memory drum was controlled by a high-speed paper tape reader reading a prepunched paper tape.

Design. Lists were presented individually to the Ss. After each item and before its instruction a blank interval of time occurred. This cue delay period was one independent variable and could assume the values of functionally zero, 1, 2, 4, 8 or 12 secs. The other independent variables of interest were the item's instruction, remember or forget and the time of recall, immediate or final.

In each third of a list each instruction was paired with each cue delay once and only once. Sufficient counterbalancing made it possible that across all Ss every word was both an F-item and an R-item, and was followed by every cue delay.

Procedure. Subjects were run individually. Each S was read a set of instructions and was shown two practice lists of 12 nonsense syllables, representing the experimental conditions to be encountered. After the practice list further questions about the experiment were answered, and then the experiment began.

Each of the lists was preceded by a 3 sec. ready signal. Items appeared for 2.3 sec., one of the six time intervals followed, and then one of the two instructions. The instruction was present for 1 sec. At the end of the list the recall signal was in view for 30 secs., during which time Ss tried to write down as many of the remember words as they could. Subjects receive 1¢ for each R-word recalled and were penalized 1¢ for each F-word intruded..

After recall of the last list, there was a debriefing period lasting several minutes, and Ss were asked to recall all of the items presented during the experimental session, R-items as well as F-items. Each item recalled earned 1¢ regardless of its previous instruction.

Results

The main results of the experiment can be seen in Fig. 1. There probability of recall is presented as a function of the time of recall test, either immediate or final; the instruction, forget or remember; and cue delay (each point is based on 576 observations.) Immediate recall of R-items decreased as a function of cue delay, final recall did not. For immediate and final recall of F-items, the longer the cue delay the higher the probability of recall. F-item final recall was higher than F-item immediate recall. Collapsed over cue delays the probability of recalling R-items and intruding F-items immediately was .473 and .025 respectively. The corresponding final recall probabilities were .269 and .059. Subjects were adept at both not recalling F-items and recalling R-items. These data are remarkably similar to data obtained by Woodward and Bjork (1971) and by Bjork and Woodward (1972) who used more, but shorter, word lists.

Figure 2 presents immediate and final list serial position curves for R and F-items. List position effects are negligible in immediate recall, strong for R-items in final recall and less strong for F-items during final recall.

Figure 3 shows the probability correct for R and F-items as a function of serial position and time of recall. Immediate recall of R-items yields a bowed shape curve with more primacy than recency. Final recall of R-items yields the characteristic poorer recall of end items found by other investigators (Craik, 1970; Cohen, 1970) and labelled the negative effect. Immediate and final recall of F-items did not vary in any consistent way with serial position.

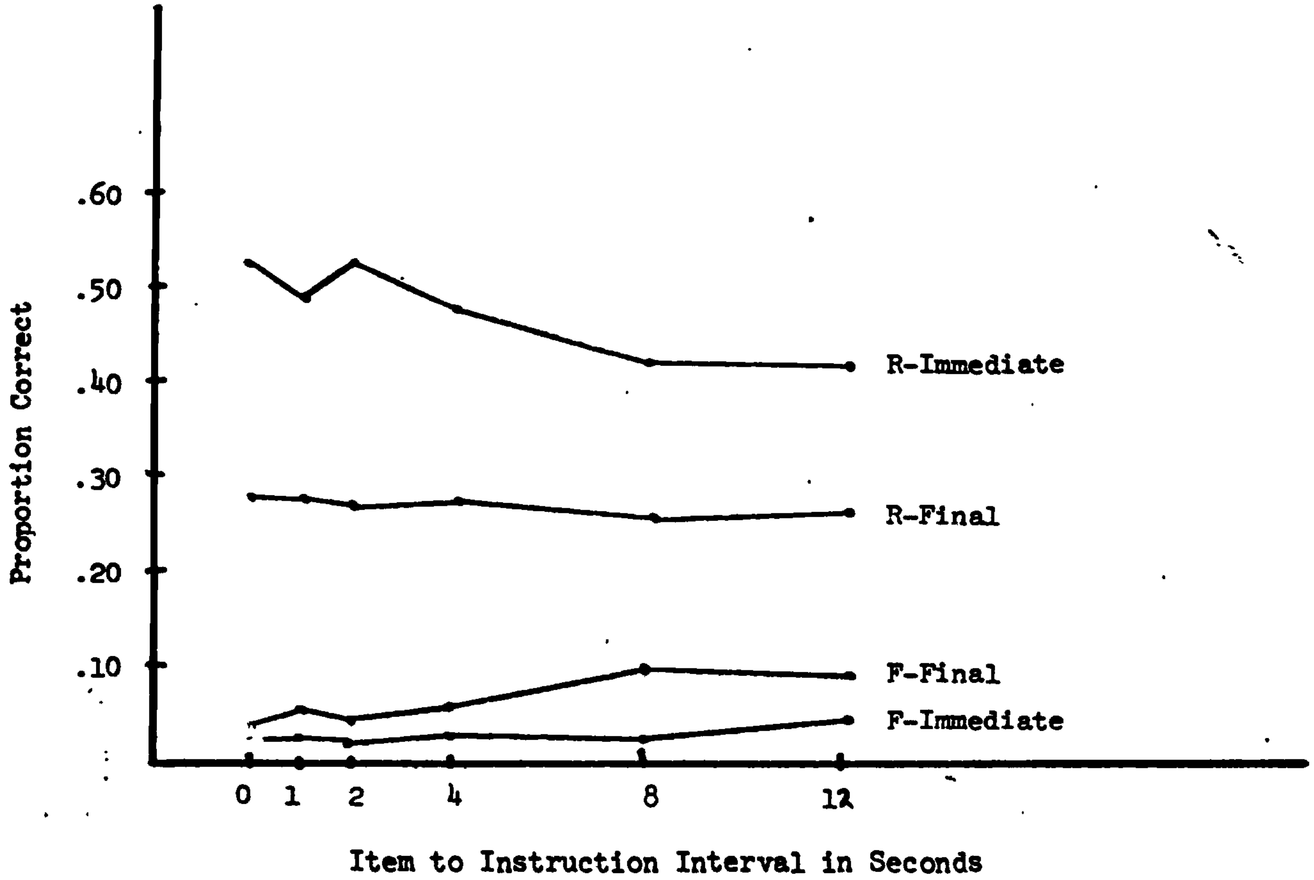


Figure I

Proportion Correct as a Function
of Time of Recall, Instruction and I-I Interval

(Experiment I)

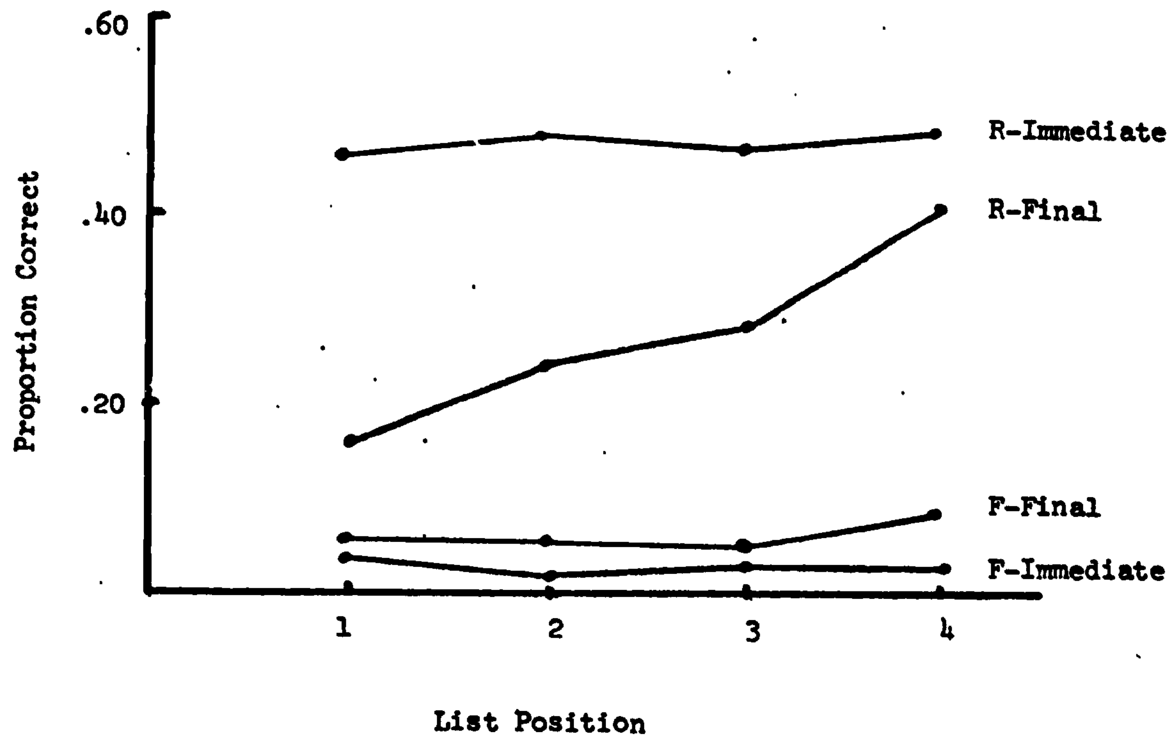


Figure 2

Proportion Correct as a Function
of List Position Instruction and Time of Recall

(Experiment I)

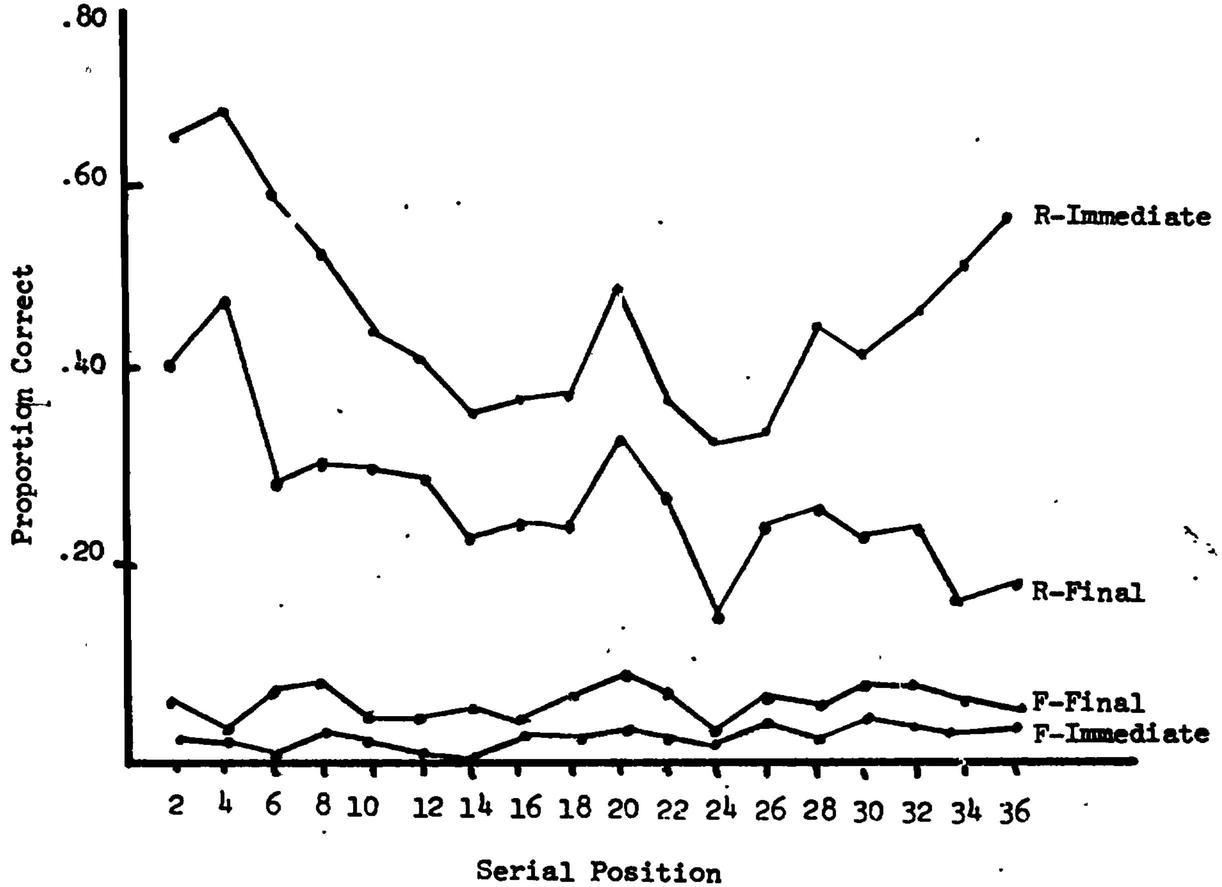


Figure 3

Proportion Correct as a Function
of Time of Recall, Instruction and Serial Position

(Experiment 1)

Discussion

The effects of cue delay were small for F-items and not in the expected direction for R-items. We expected that the longer the delay of cue, the more rehearsal Ss would give an item and the greater the likelihood of recalling the item. It is quite clear that for R-items this is not the case. Immediate recall of R-items is adversely affected by cue delay length. In fact, Ss reported an unwillingness to invest rehearsal time in items that might later be followed by a forget instruction. Instead, Ss chose to rehearse old R-items during the cue delay period.

These results seem to indicate that there may exist several types of rehearsal. One type of rehearsal, very active, involves generating inter-item associations, or retrieval cues to help the S later recall items. Another kind of rehearsal may also exist, much more akin to holding an item, perhaps maintaining its image. During the course of the cue delay period Ss probably shift from this very active rehearsal of the old R-items to reviewing or attending to the most recent item in order that it not be forgotten. The longer the delay of cue the more often S must switch activities. For F-items any attention, any review, however little, is better than no rehearsal at all. As a result, recall of F-item following a 12 sec. cue delay is better than recall of F-items following a 0 sec. cue delay. In the latter case Ss know immediately the item is to be forgotten, thus further review is obviated. For R-items minimal review is simply not as good as a rehearsal activity which attempts to generate associative connections. This type of rehearsal can begin immediately for an R-item if it is followed by a short cue delay. The longer the delay of cue the less total rehearsal time is available for the item. The result is clear, as the cue delay period increases recall of R-items decreases.

An additional analysis not reported in the result section was completed. The purpose of this analysis was to determine if the cue delay period immediately following the cue delay peculiar to a given item had any effect upon the recall of that item. If we call the item in question the Nth item, and the cue delay period following the item the Nth delay period, then the next item is the N+1 item and the next delay period is the N+1 delay period. The question we are asking is then, "Does recall of the Nth item depend on the N+1 delay period?" If, in fact, Ss were not using the Nth delay period to rehearse the Nth item, then it seemed that the N+1 delay period would be used, providing of course that the Nth item had been followed by a remember instruction. The data calculated for the middle 24 items, thus controlling for primacy and recency, indicated that recall decreased as a function of the Nth delay period and did not vary in any systematic way as a function of the N+1 delay period. In addition, no interaction existed between the Nth and the N+1 delay periods. That is, R-items followed by a 0 sec. Nth delay period and a 12 sec. N+1 delay were no more likely to be recalled than items followed by a 12 sec. Nth delay period and a 0 sec. N+1 delay period.

This analysis assumes Ss use the cue delay period to rehearse only a single item, an assumption that may not be warranted in a free recall task. It is more likely that Ss rehearse a constellation of R-items.

Thus, the analysis is not necessarily fatal to the interpretation previously given to the data reported in the result section.

Experiment II

Subjects were reluctant to rehearse the most recently presented item during the delay period in Experiment I, so Experiment II was designed to exert greater control over S's rehearsal processes. At the presentation of an item, Ss were pre-cued as to what the nature of the instruction at the end of the cue delay period was likely to be. Thus, an item was pre-cued as either an R-item or F-item and the actual cue at the end of the delay period either confirmed or did not confirm the pre-cue. Confirmation was more likely than disconfirmation, but all four pre-cue - post-cue combinations were used (R-R, R-F, F-R, F-F, where the first letter denotes the nature of the pre-cue, and the second letter denotes the post-cue.)

Subjects were told the system of pre-cues should help them decide what to do with the item before the actual cue for that item appeared. They were also informed of the probabilistic nature of the pre-cues, but were urged to accept the pre-cue at face value and act accordingly, in spite of the infrequent cases when pre-cues and post-cues would be inconsistent. In addition to the type of item, the other independent variable was the delay of cue and in this experiment the values could be 0, 1, 4, and 12 secs.

This experiment raises the question about the extent to which an S's rehearsal can be controlled. Will pre-cuing be effective? Will Ss accept the pre-cues at face value? Is it possible to experimentally control and direct what Ss rehearse by the use of pre-cues? These are questions which can be asked and answered by Experiment II.

We expected the following if Ss were to accept the nature of the pre-cues: (1) Recall of R-R items would be positively related to cue delay. These are items S is told will be R-items and, in fact, are, thus S should begin to rehearse them immediately. The longer the delay of cue, the more rehearsal should occur and the higher recall should be. (2) Recall of F-F items would not vary as a function of cue delay. These items S thinks he must forget and, in fact, he does, thus he should not attempt any rehearsal of them and cue delay will have no effect. (3) Recall of R-F items would be positively related to the cue delay period. These items, because of the pre-cue, S will think should be remembered. He will rehearse them only to find that they are actually to be forgotten. The longer the delay of cue, the more rehearsal the item should receive and the harder it should be for S to forget the item. (4) Recall of F-R items would be negatively related to the cue delay period. These items S expects should be forgotten. He will not rehearse them but then will discover they are to be remembered. The longer the delay of cue the more likely they will be forgotten and thus recall will decrease as a function of the interval. On the other hand, if Ss were unwilling to use the pre-cues, recall of F-R items would approximate recall of R-R items and recall of R-F items would approximate recall of F-F items. That is, Ss would not behave according to the pre-cues. Only the cue itself would direct rehearsal and have any salience to the S.

Method

Subjects. Forty-eight Ss were drawn from the summer subject pool at the University of Michigan. They received $1.00 and any bonuses accruing from the payoff system used in the experiment.

Materials and Apparatus. Each S viewed four 36 item lists. The words were drawn from the same pool as those in Experiment I. The apparatus, the duration of the ready and recall signals, the number of R and F items per list, and the payoff system were identical to those used in Experiment I.

Design. Lists were presented item by item to the S. After each item and before it's instruction a variable blank interval of time occurred. This cue delay period could assume the values of 0, 1, 4, or 12 secs.

Each item was either highlighted in yellow or not and was followed by a red or green dot. The presence or absence of the highlight served as the pre-cue, the green or red dot, the actual cue. The highlight indicated the item would be followed, in all probability, by a green dot. Depending upon the S, the green dot could mean remember the item, while the red dot could mean forget the item.

In each 12-word segment (one-third) of a list, six items were highlighted and six were not. Four of the six highlighted words were followed by a green dot while four of the non-highlighted words were followed by a red dot. Red dots followed the two remaining highlighted words and green dots the remaining two non-highlighted words. Every 12 items then, contained six items that were to-be-remembered and six that were to-be-forgotten. Eight of these 12 items had cues consistent with pre-cues, four did not. Across all 48 Ss each item served in each pre-cue and cue condition and at each of the four cue-delay conditions. In addition, serial position effects within a list were controlled across Ss. Four different timing tapes, three list tapes and a simple reversal of the meaning of the red and green dot were required to accomplish these controls.

Results

Figure 4 presents the main results of Experiment II. Both immediate and final recall of F-F and R-F items increased as a function of cue delay. Final recall probabilities were higher than immediate recall probabilities for these items. R-F items immediately and finally were consistently more likely to be recalled than F-F items, but in absolute terms the differences between these items were quite small. Across cue delay the probability of recalling R-F items immediately and finally was .053 and .084 respectively. The corresponding recall probabilities for F-F items were .018 and .052. The F-F items behaved very much like the F-items in Experiment I. Immediate recall of R-R and F-R items decreased with the I-I interval. Final recall of these same items was not systematically related

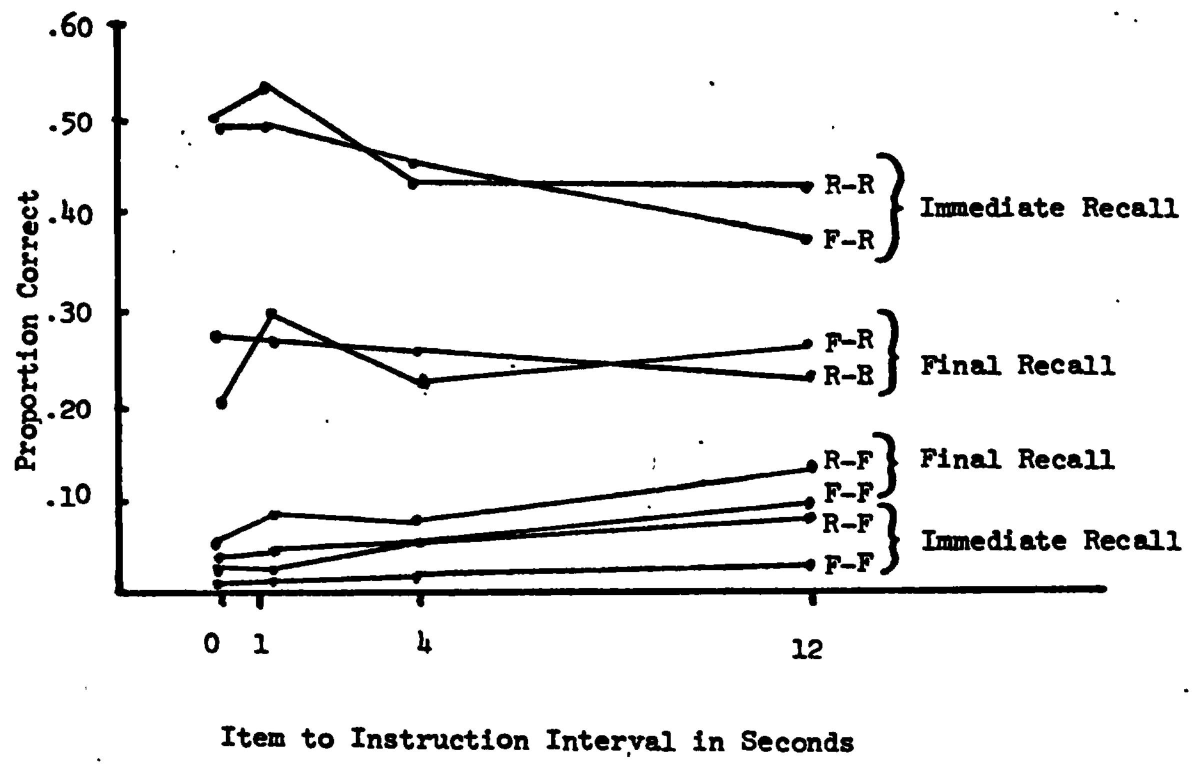


Figure 4

Proportion Correct as a Function
of Time of Recall, Instruction and Cue, and I-I Interval

(Experiment II)

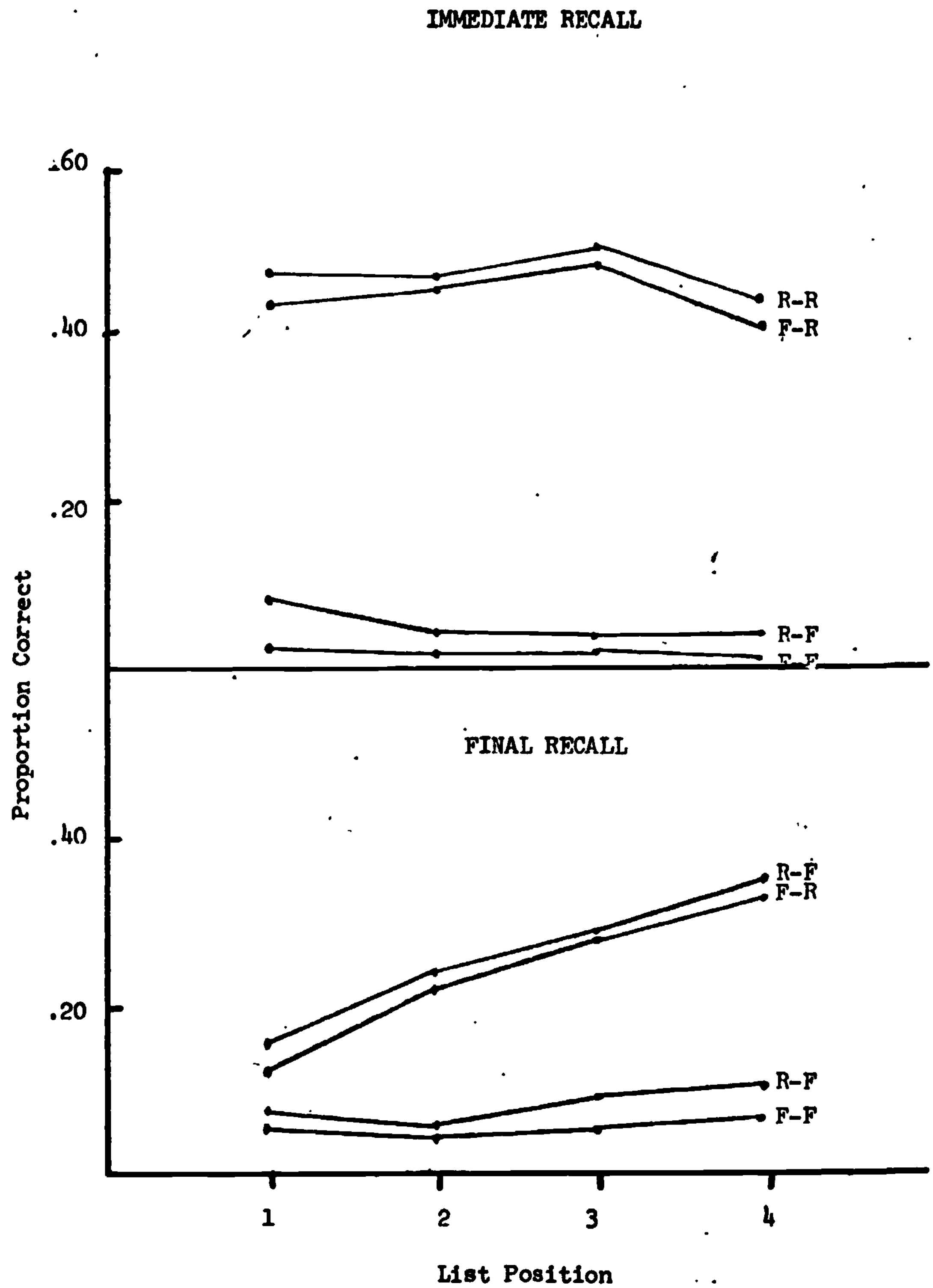


Figure 5

Proportion Correct as a Function
of List Position, Instruction and Cue, and Time of Recall

(Experiment II)

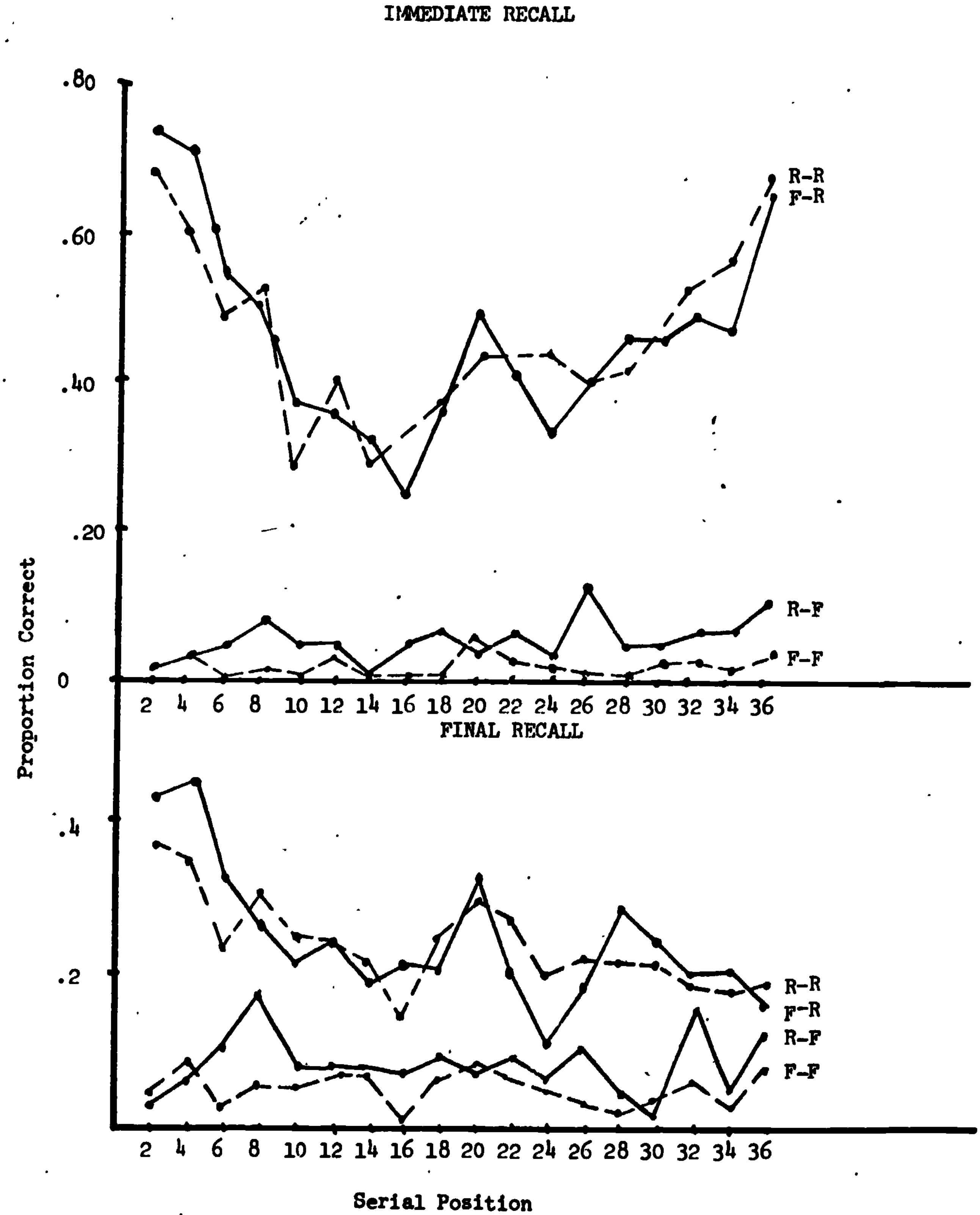


Figure 6

Proportion Correct as a Function of Serial Position, Instruction and Cue and Time of Recall.

(Experiment II)

to the interval duration. Collapsed across cue delay, the probability of recalling R-R items immediately was .472 and, finally, .257. The corresponding recall probabilities for F-R items were .447 and .241.

R-R and F-R items were equally likely to be recalled immediately and finally. The pre-cue seems to have been ineffective. Both immediate and final recall probabilities of F-R and R-R items were very similar to the recall probabilities reported for R-items in Experiment I.

The most striking aspect of both Fig. 1 and Fig. 4 were the very small effects the cue delay period had upon recall relative to a 1 sec. instruction or cue period. Past research has demonstrated sizable effects from retention intervals ranging from 0 to 12 secs. (Peterson & Peterson, 1958) or from rehearsal periods of the same range (Hellyer, 1962.) The effects shown in these experiments, as a function of the cue delay period, which can be considered either a retention interval or a rehearsal period, are miniscule compared to these other studies. What is not miniscule is the effect of the final cue; forget or remember that item.

Figure 5 presents immediate and final list serial position curves for R-R, F-R, R-F and F-F items. List position effects were negligible in immediate recall, regardless of item type. For items cued remember, list position effects were sizable in final recall, with little difference attributed to the pre-cues. A hint of a list position effect exists for items cued forget.

List position effects such as these, for final recall of R-items have been found in a number of experiments (Woodward and Bjork, 1971; Bjork and Woodward, 1972) besides Experiment I in this paper. These effects point to the necessity of appropriate counterbalancing in any situation where one's independent variables might be confounded with list position and where a final recall test is given.

Figure 6 shows the probability of recall for the various item types as a function of time of recall and serial position. Immediate recall of items cued remember yielded a bowed curve, with slightly more primacy than recency. The most striking aspect of the data, however, is the similarity between R-R and F-R items over serial positions. Final recall of these same items, although they exhibit the negative recency effect, are also similar.

Immediate and final recall of R-F and F-F items shows little variation as a function of serial position. R-F items do maintain a slight supremacy over F-F items, and this supremacy is fairly consistent over serial positions.

Both Fig. 5 and 6 support the notion that at least for items cued remember, the pre-cues were not effective. It makes little difference how one looks at R-item recall, across lists or across serial positions, there is simply no difference between F-R and R-R items, nor do any interactions exist with these other variables. In addition, Fig. 5 and 6 indicate that the slight differences that do exist between F-F and R-F items are maintained across lists and serial positions.

In terms of the initial questions raised by Experiment II, it is not unreasonable to conclude that a S's rehearsal processes are controlled more effectively by cues than pre-cues. The pre-cues were not effective, they exerted little control over S's rehearsal processes, Ss did not accept them.

Subjects reported that initially they used the system of pre-cues but, since the inconsistencies between the pre-cues and cues were numerous and apparent, they soon came to mistrust the pre-cues. As a result, Ss were reluctant to use the cue delay period for anything more than rehearsal of old R-items, momentary shifts between rehearsing old R-items, and reviewing or temporarily maintaining the most recent item in the short-term store or rehearsal buffer can explain the fact that F-item recall increased as a function of the cue delay period. R-F items received more of this additional processing than F-F items since initially Ss thought them more likely to be R than F-items.

Discussion

The results of both experiments clearly indicated that item duration per se, (item duration is being defined as the time the item is in view plus the cue delay), is not as crucial to retention as what happens while the item is being presented. If Ss are unwilling to try to develop inter-item associations, or other types of retrieval cues, no matter how long the item is in view and no matter how long it is until the next item is presented, the S simply will not remember the item.

The present experiments strongly implicate the role of control processes (Atkinson & Shiffrin, 1968) in memory research. It is quite apparent that Ss are able to make decisions based upon the E's instructions and upon the task. These decisions are decisions about an item's importance or priority and, in fact, determine to what extent and how the item will be processed. In Experiment 1 Ss refused to use the cue delay period for rehearsal of the most recent item, choosing rather to rehearse old R-items, items that they knew were now worth being recalled. In Experiment II, Ss chose not to accept the system of pre-cues.

Related to the notion of control processes are various types of rehearsal Ss may or may not use. In these experiments one can distinguish between two types of processing. One type, is a sort of holding process. The S holds the item in memory, not rehearsing it much, perhaps occasionally reviewing it, strengthening the item if it grows too weak. It is this type of processing that appears to be used for the most recent item during the cue delay period. Another more complete type of processing occurs for old R-items during the cue delay period and involves developing inter-item associations among other things, which will benefit later retrieval.

Relative to the initial goals of this research, one question remains unanswered. We still do not know whether Ss can intentionally forget items that have been processed more than superficially. The fact that cue delay manipulations were partially effective in making F-items resistent to forgetting would seem to indicate that Ss will not be able to forget items that have been processed as ably as they can forget items that have not.

Experiment III

Experiment III was designed to investigate the effects of cue delay in a more effective fashion. It seemed that if we were concerned about what the Ss were doing during the delay interval with the most recent item, we could at least insure its retention over the interval by requiring Ss to recall the item. During the experiment Ss were presented lists of words. Each word was followed by a delay period which varied from 0 sec. to 12 secs. Following the delay, was a presentation test in which Ss recalled the most recent item. After the test, the item's instruction appeared, then the cycle was repeated. Immediate recall tests occurred after each list and a final recall test occurred at the end of the experiment, and then a final recognition test was administered. Subjects tried to recall remember words (R-words) and not F-words during immediate recall tests, and tried to recall all words during the final recall test.

This experiment then attempts to investigate the availibility and accessibility of items (F-items and R-items) in a list prior to the item's instruction. It raises the following questions: In what way does the delay interval affect immediate retention of R-items and the ability of Ss to forget F-items? How does the delay interval affect later recall and recognition of all items? These questions are similar to the ones asked by Experiments I and II, but whose answers were contaminated by the fact that no guarantee existed that Ss had retained any items over the delay intervals. Here, such a guarantee exists since Ss must recall each item after the delay interval.

Method

Subjects. Twelve Ss, six males and six females, were drawn from the University of Michigan summer subject pool, and participated in this experiment. They were paid $1.00 plus any bonuses that resulted from the payoff system used in this experiment.

Materials and Appartus. Every S viewed four 36-item lists. The items were all common four-letter nouns. Each list began with a 3 sec. ready signal and ended with a 30 sec. recall instruction. Items were in view for 1 sec., as was the instruction. The presentation test that occurred for each item after the delay interval and before the instruction was signalled by four ????, and was limited in duration to 1.5 sec. Eighteen randomly selected words were followed by remember instructions and 18 words by forget instructions. In each third of the list, six R-words and six F-words appeared. The apparatus employed was a high-speed memory drum (change time less than .05 seconds.) The words, the cues to forget or remember and the instructions to recall or get ready for the next trial all appeared in the same window. The timing of advances of the memory drum was controlled by a high-speed paper tape reader reading a prepunched paper tape.

Design. Subjects viewed lists item by item. After each item and before the test on that item, a blank interval of time occurred. This cue delay period was one independent variable and could be 0 secs. (50 mesc.), 4 secs., or 12 secs. in duration. Following the cue delay was a recall test on that item, and then the item's instruction. The other independent variables include the item's instruction and time and type of retention test, immediate recall, final recall, and final recognition. Appropriate counterbalancing was incorporated into the design and insured that across Ss all items were followed by each type of instruction in combination with each delay interval. In addition, within a list every six items contained three R-words and three F-words at each of the three delay intervals. The final recognition test was composed of 144 old items and 144 new four-letter noun distractors.

Procedure. Subjects were run individually. In addition to the four experimental lists, one practice list of 12 nonsense syllables was presented to the Ss. The instructions stressed that words followed by remember instructions should be remembered for the recall test following list presentation, and that each word should be "held" for the duration of the delay interval so that Ss might be able to say it aloud when the presentation test occurred.

At the end of each list a recall signal was in view for 30 secs., during which time Ss tried to write down as many of the remember words as they could. Subjects received $1.00 for each R-word recalled and were penalized 1¢ for each F-word intruded. At the conclusion of the experiment, Ss were asked to recall all of the items presented during the experimental session, R-items and F-items. Each that was recalled earned 1¢. After the final recall test, Ss were administered a final recognition test, the task being to circle items seen during the experiment. Subjects earned 1¢ for each old item recognized but were penalized 1¢ for labeling new items old

Results. The probability of recalling items on the presentation test decreased from .99 at the 0 sec. delay interval to .96 at the 4 sec. delay, and .87 at the 12 sec. delay. There were no significant differences in recallability on this test between items later labeled forget and items labeled remember. All subsequent data to be presented were conditionalized upon correct recall on the presentation test.

Table 1 presents immediate and final recall probabilities for R and F-items as well as final recognition data, as a function of the delay interval. Immediate recall of R and F-items does not vary as a function of the delay interval. Subjects recalled about 40% of the R-items and intruded 5% of the F-items. Final recall data indicatea ome positive effects of the delay, but these were not large.

TABLE 1

Probability of Immediate Recall, Final Recall and Final Recognition as a Function of Item Type and Delay Interval, Conditionalized upon Recall on the Presentation Test. (Each point is based upon 288 observations.)

	Delay Interval		
	0 Sec.	4 Sec.	12 Sec.
	Immediate Recall		
Remember	.39	.41	.39
Forget	.06	.05	.04
	Final Recall		
Remember	.25	.31	.30
Forget	.09	.10	.14
	Final Recognition		
Remember	.66	.76	.80
Forget	.48	.59	.66

Final recognition data, shows dramatic effects of the delay interval for R-words as well as F-words. The probability of a correct recognition increased by 15% from the 0 sec. delay interval to the 12.0 sec. delay interval for both R and F-items.

Discussion

The data pose a paradox. Recall, either immediate or final, of R or F-items was affected only slightly by the delay interval, but recognition showed dramatic effects as a function of the delay interval. One explanation would delineate two types of rehearsal activity. One activity, the one that Ss use during the delay interval is a review in the literal sense. The S keeps the item "alive", not by active rehearsal so much as by reconstructing the image perhaps, or covertly recalling the item in isolation from other items. It may be easier to decide what the S is not doing, he is not actively rehearsing the item, and he is not developing inter-item associations or retrieval cues. To some extent, this "review" or passive rehearsal process is not effective in that the presentation test does not yield perfect recall. When S receives the instruction for the item, and when the instruction is remember, he rehearses the item in earnest. This rehearsal is active, and is characterized by an attempt to develop associations, or other such retrieval cues. Recall, either immediate or final, depends upon this kind of rehearsal. Thus, recall is little affected by the length of the delay interval. Recognition is not as dependent upon this active rehearsal as is recall. In fact, the passive type of rehearsal described earlier seems to have dramatic effect upon correct recognition. The longer the delay interval, the more opportunity for such passive rehearsal, and the higher is recognition. The fact that R-word recognition is higher than F-word recognition indicates that recognition does depend in part upon active rehearsal too.

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THE EFFECT OF IMPLICIT AND EXPLICIT INSTRUCTIONS

TO FORGET IN A DIRECTED FORGETTING PARADIGM

The ability of Ss to differentiate between items which are to be remembered and items which are to be forgotten has merited a significant amount of research (Woodward & Bjork, 1971; Epstein, 1969, 1971; Elmes, 1969.) Various experimental designs have incorporated either implicit (Epstein, 1969, 1971) or explicit (Woodward & Bjork, 1971; Davis & Okada, 1971) instructions to forget in order to investigate directed forgetting in memory. Implicit forget instructions typically ask Ss to exclude some portion of the input at the time of recall from output (Epstein, 1969.) Usually, Ss are not asked to recall those excluded items, thus the implicit forget label.

Explicit forget instructions are most often incorporated in experiments using item-by-item cuing. Subjects are presented list items, with each item being followed by either an instruction to remember or an instruction to forget. A final recall test is used to determine the effectiveness of the forget instruction.

Both kinds of experiments have been labeled instances of intentional forgetting or directed forgetting. Presumably a search for the mechanisms underlying forgetting as a result of implicit forget instructions would also explain forgetting as a result of explicit forget instructions. It is the contention of this author, however, that the basic phenomena resulting from implicit or explicit forget instructions are markedly different, and although each paradigm may tell us something about the memory process, neither tells us much about the other.

The present study brings together within a single experiment both implicit and explicit forget instructions. The focus will be on the fate of those items instructed forget, at immediate recall, at final recall, and at final recognition.

Within each of six lists there will be three classes of items; items followed directly by a forget instruction, and two remaining sets of items followed by remember instructions but functionally separate. Each list will be followed by one of six recall instructions. If one set of R-items is labeled A, the other B, then the recall instructions include - recall only A, recall only B, recall A then B, recall B then A, free recall A and B, and finally, after one list, Ss will be asked to recall all the items, even those followed by explicit forget instructions. At the conclusion of the experiment a final recall test will be administered, followed by a final recognition test.

The data of interest then will be the probability of recalling immediately and finally the explicit F-items in comparison with B-items in the recall only A condition, A-items in the recall only B condition, explicit F-items and A and B items in the recall all condition, and whether an only effect is established. The only effect refers to the superiority of only A or only B over the A recall of A then B, or the B recall of B then A.

Method

<u>Subjects</u>. The <u>S</u>s were 60 undergraduate students at Albion College. They participated in order to fulfill introductory course requirements.

<u>Materials and Apparatus</u>. The <u>S</u>s were presented with six 24-item word lists. All items were four-letter nouns. Words, cues to remember and forget and recall instructions were presented on a high-speed memory drum (change time less than .05 seconds) operated by a pre-programmed paper tape which determined the length of item presentation and recall time.

<u>Design</u>. All <u>S</u>s saw the same lists of items. Each list was followed by a different output instruction. The six instruction conditions were recall only A, recall only B, recall A and B, recall A then B, recall B then A, and a special list after which <u>S</u>s were to recall all items, A-items, B-items and F-items.

Item sets were designated by three different colors. Each word was followed by either a red, black or blue dot. Hence, there were two sets of remember items and one set of forget items differentiated by color. Each <u>S</u> was initially instructed that two colors designated remember items and one color designated forget items.

Counterbalancing techniques were employed so that, across <u>S</u>s, each item served in each of the three conditions. Also, across <u>S</u>s, each output instruction occurred at each list position with the exception of the recall all list. This condition was always paired with the third list. Each list began with a three sec. ready signal and ended with a 30 sec. recall period. Each item was shown for 3.3 secs. and each instruction for 1.0 secs.

<u>Procedure</u>. Subjects were run individually and in the initial set of instructions they were told that they would see lists of words and that each word would be followed by a colored dot which designated whether the item was to be remembered or forgotten. They were informed that following each list there would be one of six possible recall instructions and that it would be their best strategy to try to remember R-items and to forget F-items and not to try to anticipate when the special free recall list would occur, a procedure successfully employed by Reitman, et al (1971) and Bjork and Woodward (1972.) Explicit forget instructions existed at the onset of the experiment when <u>S</u>s were told which of the three colors designated forget items. Implicit forget instructions existed for A items in the "only B" condition and for B items in the "only A" condition.

The <u>S</u>s were given three practice lists, each consisting of 12 two-digit numbers in order to familiarize them with the procedure. After all of the experimental lists had been presented, <u>S</u>s were given a final recall test of both P and F-items for as much time as they needed. Following final recall, they were then given a final recognition test consisting of the original items and 144 distractors.

Results

Table 1 presents the probability of recall immediately and finally, as well as the probability of final recognition as a function of item type and recall instruction. Recall of explicit F-words is consistently lower than implicit F-words. The probability of intruding F-items immediately in the "only A" condition was .040 while the probability of intruding B-items, items that were not to be recalled either, was .119. In the "only B" condition explicit F-items were intruded with a probability of .031, while A-items were intruded with probability .117. When Ss were asked to free recall all items from the list, F-items were recalled with a probability of .081, while A-items and B-items were recalled with probabilities of .272 and .254 respectively. To summarize the immediate recall figures, we can say that explicit F-item recall remains invariant over recall instruction, A-item and B-item recall does not. In the "only" conditions, Ss recall less of the excluded items.

Data for final recall and final recognition reinforces the notion of implicit F-item superiority (B-items from "only A", or A-items from "only B") over explicit F-items. When Ss are asked to recall all items from the experiment, they still do not recall many explicit F-items, although explicit F-item recall does increase slightly from immediate to final recall. This increase is entirely consistent with past studies using the final recall procedure (Woodward & Bjork, 1971.) B-items from the "only A" condition and A-items from the "only B" condition are recalled finally about as well as they were immediately.

Final recognition data also indicates large differences between explicit F-items and implicit F-items. Implicit F-items have a much higher probability of being recognized, just as they had a much higher probability of being recalled. Final recall data, as well as final recognition data, are noteworthy not in the small differences that occur for a given item type as a function of the recall instruction, but the uniformity for a given item type across the various recall instructions. F-items clearly differ from A-items or B-items, but they do not differ as a function of recall instruction. Nor do A-items or B-items differ as a function of recall instruction, or from each other for that matter.

The data are not suggestive of an only effect. Epstein's (1969) only effect is defined as superior recall of the only condition compared with the appropriate both condition. Thus, recall of A-items in the "only A" condition is .242, and in the A then B condition .271. Recall of B-items in the "only B" condition is .327 and in the B then A condition it is .283.

Finally, it should be noted that the data reported for the A then B condition and the B then A condition do not take into account order of recall. Although Ss were asked to recall (in accordance with the instruction) A-items first followed by B-items, or vice-versa, recall of all items was scored. Taking order into account, the probability of recalling A-items and B-items is .183 and .214 respectively in the A then B condition, and .210 and .194 in the B then A condition. There is some indication then that Ss had problems differentiating between A and B items.

TABLE 1

Probability of Immediate Recall, Final Recall and Final Recognition as a Function of Recall Instruction and Item Type. (Each point is based on 450 Observations.)

Immediate Recall			
Recall Instruction	Forget	A-Items	B-Items
only A	.040	.292	.119*
only B	.031	.117	.327
A and B	.038	.271	.302
A then B	.039	.247	.250
B then A	.033	.300	.283
Free Recall All	.081	.275	.254
Final Recall			
Recall Instruction	Forget	A-Items	B-Items
only A	.048	.121	.123
only B	.031	.123	.158
A and B	.051	.135	.125
A then B	.065	.144	.152
B then A	.042	.187	.131
Free Recall All	.060	.100	.087
Final Recognition			
Recall Instruction	Forget	A-Items	B-Items
only A	.275	.435	.419
only B	.252	.369	.427
A and B	.275	.448	.406
A then B	.267	.448	.429
B then A	.248	.437	.437
Free Recall All	.271	.391	.387

* These figures represent intrusions since Ss were instructed not to recall the items in question.

Discussion

The fact that these data did not yield a significant only effect in retrospect is not surprising and is consistent with Epstein's research (1969, 1970.) Epstein found that the only effect appears only when the two groups of items are functionally separate. The interspersing of implicit items in this study through the use of the individual cuing technique resulted in a loss of the functional autonomy of each group of items and, subsequently, a loss of the only effect.

The initial recall data indicate that Ss had very little difficulty separating implicit from explicit instructions, but that making a similar discrimination within the implicit dimension (between A items and B items) was considerably more difficult, although not impossible. Furthermore, final recall data indicate that the effect of the explicit instruction was long term while the effect of the implicit instruction was short term. That is, recall of explicit F-words is exceedingly low both initially and finally, while a low probability of recall of implicit items initially (i.e., a low recall of B-items in an "only A" condition and a low recall of A-items in the "only B" condition) does not reflect a similar trend in final recall.

The data strongly support the notion that explicit F-items are different from implicit F-items. Explicit F-items are recalled rarely, immediately or finally, and do not depend upon the recall instruction. Implicit F-items are recalled with much higher probability than explicit F-items, immediately and finally, and are also more likely to be recognized as old items. In addition, even when Ss are asked immediately to recall explicitly labeled F-items, they are not successful.

The main difference, and a crucial one between explicit and implicit forget instructions is the time of the instruction. In this experiment explicit forget instructions followed the items immediately. The implicit forget instruction was delayed until the time of output and was far less effective in terms of leading to "forgetting." When the instruction is explicit, Ss can stop further processing of the item. If the item is not processed, or processed minimally, it is not likely to be recalled or intruded even though it may be recognized. Items later followed by implicit forget instructions are processed by the Ss in the same way no doubt as items that they will attempt to recall. The Ss, in an attempt to conform to the task requirements, exclude the implicit F-items from recall, or attempts to, but this exclusion in no way affects later recall or recognition.

In conclusion, the experiment and the results reported in this paper point to clear differences both in recall and recognition between items that Ss are explicitly told to forget, as opposed to items that are implicitly to be forgotten. Put another way, there are vast paradigm differences among studies that fall under the label of intentional or directed forgetting and that investigators should be sensitive to such differences.

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